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THE TREATMENT OF SILVER TAILINGS IN NEVADA.

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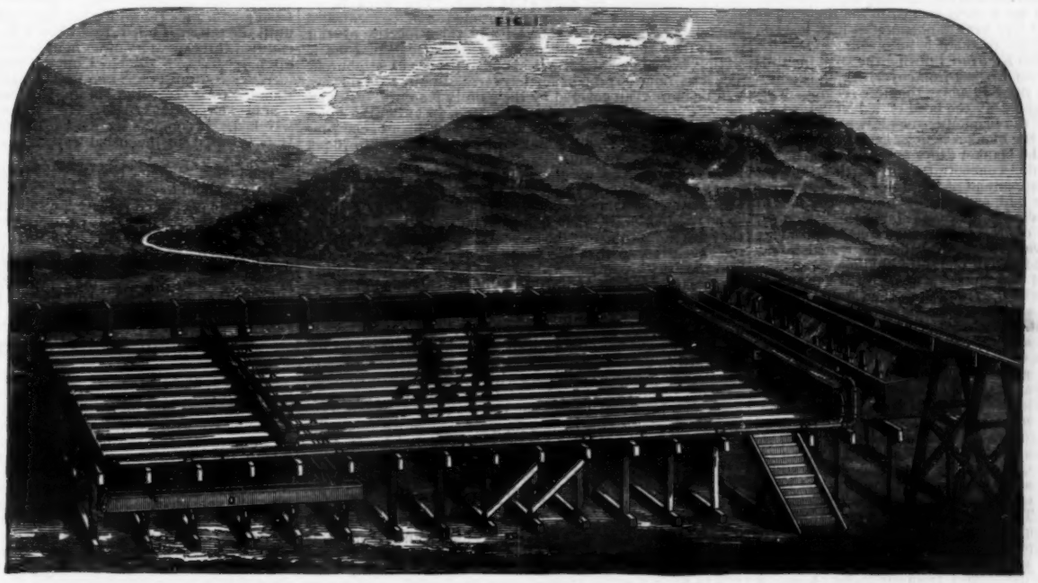
In every silver mill there are two streams, discharging one from the battery, and one from the settlers. As they are treated differently, different names are given to the residues which accumulate from them. The pulp which runs out of the settlers and agitators is called "tailings." That which comes from the stamps, and is not deposited either in the pulp or slime vats, is called "slimes" or "slums." The tails have been in contact with mercury, of mercury and amalgam, and sometimes sulphurets containing gold, which will pay to concentrate and separate.

The battery slimes are poorer than the ore, but they generally will assay about 60 per cent. of its value. They contain proportionately much less gold than the ore. The quantity of slime depends upon the amount of water used in the battery, the method of settling, and the quantity of clay in the ore. With hard ores, the amount of slimes in the best mills will be 2 to 3 per cent., with soft ores it will be more than double that quantity. Whatever gold there is in them is very flaky and likely to float; the silver is in a very fine state of division and also likely to float, and is also to pans of much larger dimensions are used, and that the slimes do not require grinding.

Generally the battery slimes are settled in a series of reservoirs. The richest material will always be in the first one. There are a large number of such slime reservoirs of great extent, that have been filled to the depth of 8 ft. to 10 ft. in Dayton Cañon, below Virginia City, Nevada, where a number of mills have been established to treat them; but the best of them do not get more than 60 per cent. of the assay of the slimes, even where they use very large amounts of chemicals, as most of them do. The bullion produced is never fine, and is less so as the amount of sulphate of copper



THE WOODWORTH SILVER TAILING SLUICES AT DAYTON, NEVADA.

the slimes or slums have not. There are thus slimes from the slime vats in the mill, which are treated with the pulp, and slimes outside of the mill, which, if caught, are collected in reservoirs. The part of the pulp which has been reduced to a slimy condition in the pan, is called pan slime, and hence there are three kinds of slimes: mill slimes, collected in the slime vats of the mill, which are treated in the pans; battery slimes, which are the overflow of the slime vats; and pan slimes, which discharge from the agitators with the tailings, and are only accidentally separated from them in the lower parts of large reservoirs. The battery slimes are usually allowed to escape, or are caught in large reservoirs below those for the tailings. The pan slimes and tailings are treated together in concentrators, or on blanket sluices principally, to catch the mercury and amalgam and heavy particles of ore, and the concentrates are treated in pans.

If the ore has been properly worked in the pans, no gold or silver can be extracted directly from the tailings and pan slimes. It is in the state of sulphurets, which cannot be separated without thorough oxidation, produced either by roasting, by chemical action, or long exposure to the action of the weather. They contain, however, a certain portion some extent in the form of sulphurets. The slimes are worth from 15 dols. to 20 dols., and often more, and can be profitably treated. When water is scarce the slimes are very advantageously treated without any special arrangement being made for it, as all the water from the slime vats is pumped up with the slimes in it, and passes again through the mill.

By this method, there are no battery slimes. It is well worth consideration whether this method would not pay even when water was plenty. The amount of water to be paid for would be less, and the gain in yield would probably more than pay for the pumping, if properly managed.

The pan tailings and slimes could be caught with a sufficient number of tanks, but the mills have not usually been built with reference to it, and could often not be altered, as there is generally not sufficient space around them for the purpose. Frequently the slimes are not valuable enough to justify much expense, so that in most of the mills only a rough attempt is made to catch the mercury and amalgam, and very large quantities of them go to waste.

The treatment of the slimes varies but slightly from the treatment of the ore, differing only in these respects, that is larger. The loss of mercury is so great that some of the tail mills (as mills treating tailings and slimes are called) purchase ore to mix with them. This loss has given rise to the invention of a number of machines for saving it.

The tailings are generally treated in blanket sluices, the attempts to treat them on concentrators not having been successful. The sluices are troughs 20 in. wide, with sides 2 in. or 3 in. high, and sometimes 1,700 ft. or 1,860 ft. long, with a grade of 6 in. to 10 in. in every 12 ft.; a number are usually placed side by side, generally three. Sometimes as many as 15 to 20 and even more are arranged together. They are covered with strips of coarse blanket, which are laid on the sluice, and can be easily removed to be washed. When the sluices are long, they are tarred on the underside to keep the blanket from rotting, in which case they are nailed to the sluice and swept. When not tarred they are taken up and washed. The tarring is done by drawing the blanket over a bath of hot liquid tar.

As the stream of tailings runs over these blankets the heavier portions are caught; the lighter portions are washed away. The loose blankets are taken up at intervals of about 12 hours, and washed in tanks; the tarred ones are cleaned

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by a man who walks over the blankets, brushing the surface lightly with a broom, thus disturbing and distributing the material, and aiding the action of the water. The material caught in the blankets is thus swept into under sluices beneath the main sluice, and is caught in tanks. While the blankets of one sluice are being cleaned by washing or sweeping, the stream is turned on to the others; so that whatever the number of sluices required to do the work may be, there must always be one more.

These sluices are sometimes owned by the mills, but generally by contractors; they usually cost about 1 dol. per foot, including the blankets. The concentrations from both kinds of blankets are worth from 18 dols. to 30 dols. per ton, and are treated in pans.

What passes the short blanket sluices is generally accumulated in reservoirs. Below Virginia City, there are immense quantities of these tailings, collected in artificially constructed reservoirs, from which, when they are full, the water is turned off, the dam and the sides removed, and the material which soon becomes thoroughly dry, carted to the mills for treatment. It is doubtful whether it will pay to save the residues of long sluices. As illustrations of the way this work is done, the Eureka Mill and Woodworth sluices have been selected.

At the Eureka Mill, the discharge from the agitators is run into a large tank, from which it is raised by an Archimedean screw, 32 ft. long and 16 in. in diameter, which discharges into a head box 10 ft. long, 1 ft. wide, and 16 in. deep. This box has six gates which open on to the same number of sluices built side by side, each of which is 1,200 ft. long. They are 20 in. wide, and are separated by strips of ¼ in. board, 3 in. high. Five of these sluices are used at a time; the sixth is held in reserve in case of accident. The blankets are 10 ft. to 12 ft. in length, and are not cut. They are tarred on the underside, and are fastened with five tacks at the upper end, and by a cleat tacked to the sides. The lower end is loose and laps over the blanket below it from 6 in. to 12 in. Every 200 ft. there is an opening across the sluice 3 in. wide, which is covered during the time the tails discharge over it, with a sheet-iron cover, which communicates with a trough running across the sluice below. This opening is always placed at the head of a blanket, so arranged that the lap of the blanket covers it while the tails are running. When the blanket is to be swept the cover is removed, the end of the blanket drops over the edge of the opening, and the blanket concentrates are carried into the trough below. The upper end of the sluice is swept every four hours, the lower end once in six hours. Six tons of concentrates are collected in a day. It takes three men per shift of 12 hours to do the work. The concentrates here have the same assay value as the ore, and are treated in the same way with the addition of one-third of slimes.

The best example of long sluices is the Woodworth sluices of Dayton, Nevada, which were designed and constructed in 1874 by W. H. Armstrong, for the Dayton Mill, of which he was superintendent. They are the largest which have ever been built, and are designed to treat all the tailings from 25 to 30 miles in Gold Cañon, or 262 stamps, being an average of two tons a day for each stamp. These are all collected in the sluice at the Bacon French Mill. This sluice is 18 in. square, 3½ miles long, with an average grade of 4 in. to the rod. It is never cleaned, but carries the collected tailings to the Woodworth sluices, of a portion of which we give a perspective view on the previous page, and which are composed of 12 sluices, S, side by side, each one of which is 19 in. wide. They are separated by strips of wood 1½ in. wide and 3 in. high, and form together a table 22 ft. wide and 1,700 feet long. These sluices have a grade of 2 in. to the rod, and are supported on trestles 4½ ft. apart. For convenience of working, the group is divided into sections of 150 ft., but each sluice is continuous. At the head of the sluice the tails are discharged from the sluice, A, into a head-box, B, made of two compartments included in the same structure. These are each 3 ft. long and 2 ft. deep, and the whole width of the sluices. The bottom of the first one, B, is 20 in. above the bottom of the sluice, and has three openings, 3 ft. wide and 4 in. high, which discharge into the distributing box, C, which has 12 openings, 4 in. by 8 in., one for each sluice. All the openings in C are provided with gates, D, so that all or any number of them can be closed at a time. In front of the box, B, is another one, E, of the same size and shape, which is fed by clear water, from the two lines of galvanized iron pipe, F, 5 in. in diameter and 2,156 ft. long on one side of the sluice, and on the other supplies it through the gate, S, to the side box, H, which is 8½ ft. wide and 10½ ft. deep, and carries the clear water to the head of the sections; it is consequently 150 ft. shorter than the whole sluice. Here it discharges through the openings, L, into boxes, M, 6 in. by 6 in., which cross the sluice at right angles, and have, like the clear water head-box, E, a 3 in. round hole, I, for each sluice, which can be closed with a plug when the blankets are not being washed. These troughs are 1 ft. above the sluice, and are supported on four inclined pieces shaped so as to leave the current free. At the end of each section there is a slot, K, in the bottom of the sluice, 3 in. wide and 17 in. long, closed by a sheet-iron cover, which opens into an inclined sluice 6 in. wide and 12 in. deep, which runs under the whole width of the table, and at right angles to it, and discharges into a trough, O, of the same size, which runs parallel to the table, and carries the concentrates to the reservoirs. This slot in the bottom of the sluice is closed when the sluice is working, and the blanket laid over it, as at the Eureka Mill.

At the end of 1,200 ft. there are ten settling tanks, 9 ft. long, 8 ft. wide, and 4 ft. deep, into which the sweepings are discharged. At the end of 1,600 ft., there are two of the same size, and at 1,700 ft. two more, making 14 in all; 140,000 ft. of lumber, 34,000 ft. of blankets, 19,000 ft. of which are in use at a time, 2 tons of nails and spikes, and 1,600 gallons of coal tar were used in the construction of the sluice. The total cost of construction was 21,500 dols.

The Woodworth sluice requires to operate it about 627 gallons of water per minute, which is pumped to a height of 2,156 ft. horizontally, through a 5 in. iron pipe. The pump is driven by the water-wheel of the Dayton Mill.

Each one of the sluices is covered with blankets 20 in. wide by 6 ft. long. They are tacked on the upper end with five eight-ounce tacks, and by one tack every 6 in. in the sides. Before they are put down they are coated with coal tar on the under side. This is done by laying the blanket on the hot tar in a tank made for the purpose, and drawing it over its surface, and then over the edge of a board at the opposite end of the tank to scrape off the excess of tar. This tank is 6 ft. long, 30 in. wide, and 12 in. deep. At one end the bottom is inclined to an angle of 35°, and reaches to the top of the tank. The blanket is drawn over the tar and out at this end. Only the under side is coated in this way, leaving the nap entirely free. The tarred blankets last nine to twelve months, but if not tarred they only last three months. They are taken up every two months to be dried, and are then shaken, at which time the bottom sluices are carefully cleaned. The blankets work better as they get older.

To work the sluice, the slime from the sluice, A, is discharged into the tank, B, (Fig. 1), and from there into the distributing box, C. The amount of slime discharged by the sluice is from 60 to 70 cubic inches per minute. It is discharged upon the blankets from the gates, D, in the trough, C, the amount being regulated by opening or closing the gates. It is thus distributed over all the sluices but one, or as many as it is desirable to have working, and is spread over the blankets.

The first three or four sections are being constantly swept, so that each section will be swept every six hours. Before commencing to sweep, the supply is cut off, and clean water turned on to the sluice from the clean water box for half an hour. The opening in the bottom of the sluice at the end of each section, which is kept closed while the sluice is not being swept, is now opened, the cover is removed, and the end of the blanket allowed to drop into the sluice below, where it remains until the men clean up this sluice. The sweeping is done with an ordinary broom, clear water running all the time. The sulphurets caught in the nap of the blankets are thus discharged into the lower sluice. The length of time for sweeping is generally calculated on the upper sluices, so that three to four of them are washed in a little less than three-fourths of an hour. Each one of the sluices is thus swept in eight hours, or three times in the twenty-four. On the lower ones, they are swept only once an hour, so that each sluice is swept once in twelve hours. Seventeen men do the whole work of the sluices, twelve of whom are sweepers. They work twelve-hour shifts, and were paid in 1874, $3 a day for sweepers, and $4 for the overseers. Afterward Chinese labor was employed, so that now the sweepers get only $1.54 a day. The work is arranged so that the sluices produce one ton of concentrated sulphurets for each sweeper. Fully three-fourths of this comes from the upper sluices. The actual cost of concentrating, with labor at $3, was about $4 per ton of sulphurets. The cost now is proportionately less. In any case the cost will be more than covered by the gain in mercury. The assay of the concentrates in October, 1874, just after the sluice commenced to work, was $25.49. In November of the same year it was $28.90. They are worked in the mill to 70 per cent. of their assay value.

The attempt to work the sluices by direct amalgamation was for a long time unsuccessful, owing probably to the precious metals being in the state of sulphurets which require to be roasted, or of their being included in pyrites so that they are not reached by the mercury. Roasting is generally too expensive, so that this material is either thrown back into the battery, or worked in the pans. Their quantity has been very much diminished by increasing the number of slime vats in the mill. They are now treated in pans by largely increasing the amount of chemicals—which are usually only salt and sulphate of copper—over that formerly used. The amount of chemicals and mercury must be determined in each case by making assays; for the baseness of the bullion produced increases with the quantity of sulphate of copper, and cases have been known where the silver produced has been only 0·099 fine. Having once determined the average fineness of the bullion for a given quantity, this quantity is the one best suited for the slimes in hand. In general the less the amount of chemicals, the finer the bullion, but the greater the loss of precious metal will be.

As slimes require no grinding, it would seem most advantageous to charge the quicksilver directly into the pan, but experience has shown that better results are obtained by charging the chemicals with the slimes, and thoroughly mixing them for about two hours with the muller up, and then adding the quicksilver. With slimes assaying from $20 to $30 a ton, the average quantity of sulphate of copper for tailings is from 10 lb. to 12 lb., and of salt from 20 lb. to 25 lb. The charge is worked for four hours, or six hours in all, and then drawn into the settler. About 60 per cent. of the assay value is obtained. The yield of the pan being from 60 to 75 per cent., if the slimes are successfully treated, may bring the yield of the ore up to 85 or 90 per cent.

In treating slimes the greatest source of expense is the apparently inevitable loss of mercury. With all the best advantages it will generally be as much as 4 lb. to the ton of ore. In the treatment of ore it will not generally exceed from 1 lb. to 1½ lb., and sometimes averages as low as ¾ lb. This loss is probably owing to the slime forming a coating over the globules of mercury, and preventing their uniting. When ore is treated with the slimes the loss in mercury is always found to be less, and the yield of silver higher; this is probably owing to the more or less grinding action of the ore which cleans the mercury.

It was supposed for a long time that sodium amalgam, cyanide of potassium, and a number of other chemicals, would have the effect of preventing the loss of mercury to a very considerable extent, and they undoubtedly do temporarily "enliven" the quicksilver. But their action is only temporary, and it is doubtful whether it is of any great amount of use.

As these slimes, and sometimes low grades of ore, are poor, it is necessary to work them in very large quantities in order to make them pay. This is done by using very large pans, and it is mostly for this purpose that the largest pans have been invented.

The examples of the treatment of tailings, slimes, and concentrates from the blanket sluices in pans, are taken from the Woodworth and Lyon Mills in Dayton, Nevada. The Woodworth Mill treats the slimes mixed with ore worth $20 a ton, and for that purpose has six batteries of four stamps each. It has twelve horn pans, six settlers, two agitators, and one clean-up pan. The Lyon Mill treats only tailings, slimes, and the concentrates from blanket washing. It has ten Wheeler pans with wooden sides and covers, five settlers, and one clean-up pan. The slimes have been deposited in reservoirs from the mills above. The dam and sides have been removed, and the material, which is perfectly dry, dug out of the bank, and carted to the mill. They are worth from $30 to $40. The concentrates come from the Woodworth sluices. In the Woodworth Mill the pans are 5 ft. inside diameter, have eight dies and six shoes which are 18 in. from side to side on the widest part. One end of the shoe is only 4 in. wide, the other is 18 in. The ends are joined with a curve, so as to form a decided point on the long side of the shoe. The diameter of the shoes and muller is 4 ft. 10 in., so that there is one inch between them and the side of the pan. The charge for the pan is 1,600 lb. of tailings and 400 lb. of pulp; but when of ore alone, the charge is 3,000 lb. The muller revolves 85 times a minute. Twenty pounds of sulphate of copper and 40 lb. of salt are put in with the charge. When slimes are treated the muller is never down, and 200 lb. of mercury are introduced at the end of two hours. The whole operation lasts 4½ hours. When ore is charged the pan grinds for three hours, then 100 lb. of mercury are added, and the operation continued with the muller up for 1½ hours. When the operation is finished the contents of the pan are drawn into settlers.

The sides of the pan are made of sheet iron and lined with wood. This is done because it has been found that the mercury forces itself through the pores of the wood, and also that there is a loss of mercury where it leaks. This loss is prevented by the sheet-iron sheath, or if it takes place, the mercury is caught in the groove round the bottom of the pan.

In the Lyon Mill the pan is 5 ft. in the inside diameter and 4½ ft. deep. The charge is three tons of dry tailings, which are mixed with water, discharged into a pan through a 1½ in. pipe. During the time the charge is being made, the muller revolves 70 times per minute. The pan is filled to within 6 in. of the top, or just as full as it can hold without slopping, the pulp being in a state of thick mud. The shoes are always raised ¾ in. from the bottom. Half an hour after the charge is introduced, 40 lb. of salt and 74 lb. of acid sulphate of copper, containing a large amount of sulphate of iron, is added. This material is the refuse from the crystallization vats of the "bluestone" manufactory owned by the mill. It could not be sold, and the company find it cheaper to use it in their own mill than to recrystallize it. One hour after, the charge of 100 lb. of mercury is introduced, the full amount being charged at one time. In 29 days 340 flasks of 76½ lb. each were used on nine pans. The pan revolves for three hours after the mercury is added, and is then drawn into the settlers. In the Woodworth Mill the settlers are 10 ft. in diameter, 3 ft. deep, and the arms make 14 revolutions per minute. In the Lyon Mill they are 8 ft. in diameter, 4 ft. 8 in. deep, and make 15 revolutions a minute. No mercury is ever taken from the pan; it is all discharged into the settler from a pipe in the bottom. Water from a 2-in. pipe runs into the pan while it is discharging, until the settler is filled to within 6 in. of the top. It is emptied three quarters of an hour before the pan is ready to discharge. From the bowl on the side of the settler the mercury is dipped out to go to the strainers, which are surrounded by a sheet-iron sheath, reaching nearly to the bottom of a large iron vessel. After straining, the amalgam is weighed. It contains six parts of mercury to one of silver. It is retorted in the usual way, and is worth from $50 to $60.

The loss in mercury is only ¼ lb. to the ton; but this exceedingly small loss is owing to the fact that when blanket concentrates are treated, there is a gain in mercury from them which reduces the apparent loss. In one of the mills of this vicinity, where twenty pans were run on tailings alone, nine flasks of mercury were gained over and above all the losses in six weeks. The real loss is probably as great, if not greater than in working the pans. When ore is treated alone in the Woodworth Mill, the loss is 1¾ lb.—*Engineering.*

PROGRESS IN SHIPBUILDING.

THE additions that are now being made to the mercantile marine of the world may be said to have once more put the art of shipbuilding on its trial. Nearly a dozen steamers are being constructed at present that are expected to exceed in sailing qualities the finest vessels afloat. Every other month the English newspapers have announced that first this and then that great shipping company has contracted for the construction of two or three vessels that are to outstrip all their predecessors; and the latest announcement of the sort comes from the Cunard Company, who have ordered a screw steamship of 7,000 tons, to be built of steel, for their Transatlantic service. The success of the Livadia, and the continual improvements taking place in the Royal Navy, show that in other departments also the art of shipbuilding is making vast strides. But we have become so accustomed to changes and advances in shipbuilding that they cease to impress us with their rapidity or magnitude. At present it is premature to speak of their success; that can only be tested by actual working; and it will be two or three years before that test can be applied in the case of the largest additions to the mercantile marine. In the meantime, however, we can take stock of the changes already made and estimate their value, and from these data indicate the direction in which we are moving. For this purpose it is not necessary to go back into the ages of shipbuilding traditions. Events have occurred within living memory that sufficiently illustrate the movements of this department of art and industry. We call it an art in contradistinction to a science, because the most modern improvements are nearly as tentative in their character as the oldest were.

The first and foremost feature of the present shipbuilding trade is its birthplace. It is now considered trite to remark that England is the greatest shipbuilder in the world. But 20 years ago some of the highest authorities on the subject thought that this remark instead of being trite was not true. Thirty years ago an English naval architect, who had no superior in his profession, not only admitted as undeniable that the Americans were then ahead of the English shipbuilders, but thus accounted for the loss of England's character as mistress of the sea. The Americans, he said, constantly on the alert, have carried out and applied every new discovery to the advancement of navigation, while with the English, naval construction and seamanship are exactly that branch of practice in which science has not only been disregarded, but is altogether despised and set aside. The American ships show what can be done by modern science unflinchingly put in practice; the English show what can be done in spite of science and in defiance of its principles. The circumstances that occasioned these remarks prevailed for fully a dozen years. America was than considered the pioneer in shipbuilding. She produced the fastest sailing vessels afloat; she built some of the largest vessels in the mercantile marine; and she was the first to demonstrate the superiority of armor plating in naval warfare. America then appeared to be fast attaining naval supremacy. Now, we may exclaim, How have those promising shipbuilders fallen! In the beginning of 1862 the English Government found, on taking stock of that portion of its fleet fit for naval battle, that, measuring by the standard of efficiency which the Americans had reached, it had only one ship of the line. Now America has not a single ship of the line, except one on the stocks. In no country has shipbuilding declined so rapidly as in America; in none has it improved so steadily as in England; and the movement in both directions has been especially marked during the last ten years.

Another feature of recent improvements—perhaps the most prominent of any—has been the increased size used in the construction of the latest vessels. It is true that none of their dimensions have yet reached those of the "Great Eastern;" but they are so gradually approaching it

as to raise a grave doubt on the minds of some naval architects as to whether the limits of size convenient for manipulation have not been reached. The point is one which only experience can determine. A capacity of 7,000 tons is nearly double that of the ordinary size of some of our best ocean-going steamers; and if the requisite conditions as to speed and easy manipulation can be obtained by means of improved mechanical appliances, the increase of economy in working resulting from increase of size makes the experiment worth trying. The lighter and better material—steel—that is to be used in the construction of this, the largest of ocean-going steamships, is likely to be of great advantage. Vessels built for our great sailing "lines" do not need to be hampered by the restrictions imposed by Lloyds as a standard of seaworthiness. The company which is about to make this great experiment in the use of steel has the reputation of never having lost a passenger during the 40 years their vessels have been crossing the Atlantic. They can, therefore, be trusted with the duty of insuring the safety of their vessels; and at the same time they can afford to adopt an experimental instead of a conventional standard of security. When the use of steel for shipbuilding was under discussion a few years ago, an elaborate inquiry was instituted by Lloyds with the view of ascertaining what allowance in weight should be made in steel ships on account of the superior character of the material employed. The commission who conducted the inquiry ultimately came to the conclusion that a reduction of 30 per cent. might be allowed in the weight of steel as compared with iron; but to make assurance doubly sure Lloyds only allowed a reduction of 20 per cent. The improving quality of the steel plates now used, as well as the improving knowledge of their manipulation, point to the possibility of increasing rather than diminishing the reduction of weight compatible with perfect safety. Then, again, it is well enough known that large passenger steamers are not liable to the same risks of strain in working that vessels carrying deadweight cargoes are exposed to. In these circumstances the extreme size of the passenger steamers that are now being built has *prima facie* evidence in its favor, notwithstanding the comparative failure in point of utility of the greatest experiment ever previously made in the same direction, made, however, under different conditions and with different materials.

As to principles of construction, so much novelty and variety have recently been introduced, and with so much success, that this subject is now of as controversial a nature as if naval architecture were still in its infancy. In this respect the steamship presents a singular contrast to the steam locomotive. In principle the steam engine is the same as it was when it left the inventor's hands 80 years ago. The progress of succeeding years only altered its form. In shipbuilding, however, form is still regarded as the secret cause of efficiency in new made ships. Formerly theories of "wave lines" were elaborated with a degree of precision that led their authors or advocates to arrogate for them the certainty of science; but the most elaborate of these theories has just been demolished by the extraordinary form and still more extraordinary success of the Livadia. It is scarcely five years since the failure of the Castalia—the twin ship—to attain a high speed, along with the least degree of pitching and rolling, seemed to confirm the old theories of naval construction as to form and breadth. Now, the Livadia has upset the naval traditions of ages, for according to the high authority of Sir E. J. Reed, that yacht, whose naval form is already pretty well known, has demonstrated "the fact that very great breadth of ship is compatible with very high speed."

Perhaps no feature of our shipbuilding trade deserves more attention, and perhaps none has received less, than the greater security it affords for the safety of human life. The progress that is taking place, not silently, but almost imperceptibly, in this department of nautical administration is one of the most creditable features of the trade. The public do not yet feel so secure on board ship as in a railway carriage, and just after a storm which is said to have caused a number of wrecks that is almost unprecedented, it scarcely appears opportune to boast of an improvement in the security of life at sea. Nevertheless real progress is being made in this direction also. In both nautical and railway management a similar system has been organized in England for the detection of preventible causes of loss of life; and although it has not yet had time to effect sweeping reforms in the mercantile marine, yet there is good evidence to show that loss of life at sea now is less, in comparison with the bulk of shipping afloat, than it was 20 years ago. This subject is not one that admits of exact arithmetical demonstration. Statistics enough are available on the loss of life at sea, but the varying conditions under which these losses from time to time occur, as the recent exceptionally heavy losses on the British coasts show, do not afford equal bases for comparison. At the same time we are in a position to state that an examination of the loss of life in comparison with the volume of our shipping trade over extended periods of time, show that through improvements in naval construction and administration the risks of lost at sea are sensibly diminishing. There is every prospect also of this improvement continuing. Vessels of the Atalanta and Eurydice type, which 20 years ago were looked upon as models, are now generally condemned as unsafe, and their disappearance or disuse should still further diminish the risks of loss. While, on the one hand, improvements in construction are thus promoting safety, on the other we look forward with hope to the use of improved means for lessening unavoidable dangers. During the last two or three weeks experiments have been made for the purpose of showing how the passing of small quantities of oil on an angry sea can be systematically employed for insuring the safety of vessels in the most tempestuous waters. To us it has appeared strange that some such means have not been systematically used before now. Instances have occurred now and then in mid ocean where vessels with stores of oil on board have through stress of weather been obliged to throw part of their cargo overboard, and when some barrels of oil were in this way emptied into the sea, the sailors were amazed to see that the troubled waters became smooth. Necessity is said to be the mother of invention, but in cases like this the invention is apt to be unused for the simple reason that it has no inventor with patent rights to press its utility upon public notice. At present, therefore, we are glad to see that experiments are being made with the view of facilitating the use of oil for this purpose, and we look hopefully for good results to be ultimately realized. At all events such a remedy should not be despised on account of its simplicity. Nature's greatest remedies are simple.

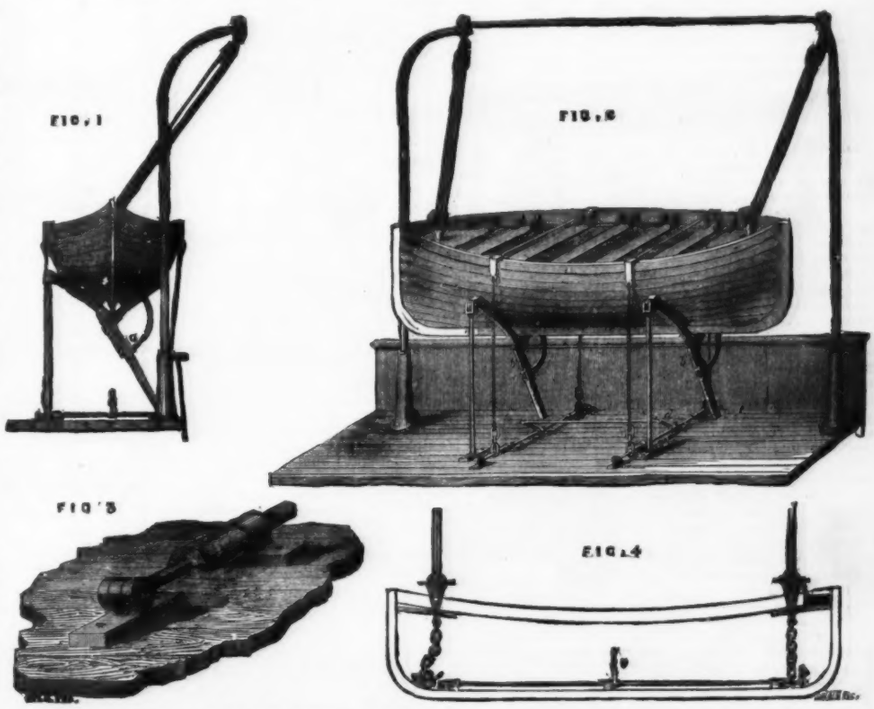
This short survey shows that amid the many uncertainties and urgent requirements with which naval architects have now to deal, undoubtedly real progress is observable in all departments of this great industry. The next few years are destined to bring forth, not perhaps the most revolutionary, but certainly the finest improvements, applied on the largest scale hitherto attempted; and whatever else may be said about the ultimate efficiency or permanent benefit of present effort, who dares nowadays to cast the reproach at English shipbuilders that theirs is "exactly the branch of practice in which science is not only disregarded, but is altogether despised?"—*Universal Engineer.*

IMPROVED BOAT-LOWERING APPARATUS.

THE advantages claimed for this apparatus are: (1) The greatly increased speed with which the boat may be swung out of the chocks, lowered into the water, and detached from the tackles, the whole of these operations being capable of being performed in twenty seconds; (2) it is impossible to detach one tackle without at the same moment detaching the other one likewise; (3) the cost of this apparatus is little more than that of the ordinary apparatus; and last, though not least, it possesses the advantage of simplicity, being so simple that it could be worked by any of the passengers on board the ship.

The apparatus is constructed as follows: Ordinary boats' davits are placed about a foot clear of each end of the boat, and the davit-heads are connected to each other by means of a bar, so that both the davits are moved together, and may be freely worked in and out.

The boat when on board is supported by chocks, as shown in Figs. 1 and 2, the outside halves of which are made with hinges and sliding quadrants, so that they may be let down or set up at pleasure. The outside halves are secured when up by means of catches, which slip into notches cut in the sliding quadrants, as shown at *a* in Fig. 1. These catches may be withdrawn simultaneously by means of the two levers, b b^1, which are connected to each other. Two turning bars are fitted in bearings fixed to the deck below the boat for securing the boat lashings, and are worked by two levers connected to each other, so that all the lashings can be let go at the same moment by one movement of the lever, *d*.



IMPROVED BOAT LOWERING AND DETACHING APPARATUS.

A turning bar is also fitted in the bottom of the boat, as shown in Fig. 4, for detaching the boat from the tackles. In this figure one tackle is shown loose, and the other as it would appear when the boat is in the chocks. This turning bar is worked by a single lever, *e*, so that it is impossible to disengage one tackle without at the same moment disengaging the other. The pins for taking into the chains of the tackles are made with hooks for convenience in attaching the tackles to the boat under ordinary circumstances. Fig. 3 is an enlarged view of one end of a turning bar similar to those used.

The lowering of the boat is effected as follows: The crew having got into the boat, the outside halves of the chocks are let down by moving the lever, b^1, and the boat swings out over the ship's side, but is prevented from swinging too far by the lashings. The lashings are then let go by moving the lever, *d*, and the boat is lowered by her crew, the lashings being either taken into the boat or thrown upon the deck. As soon as the boat touches the water, or, if desirable, before the boat touches the water, one of the crew turns the lever, *e*, over, and thereby disengages the boat from the tackles.

In Fig. 4 is shown to an enlarged scale the semi-tubular ends of the turning bars, and the jointed pin upon which the tackle and lashing hooks take.

The apparatus has been invented and patented by Captain Donovan, a north-country seaman of much experience in the mercantile marine, who thoroughly understands what is and what is not admissible on board a ship.—*The Engineer.*

COST OF DREDGING.

A SOMEWHAT remarkable fact is disclosed by the annual report of the California Harbor Commission. It is that a certain class of work can be done cheaper by the State than by private individuals. Not that there should be anything extraordinary in this, since the State wants to make no interest or profit, while the individual or the company does; but it seems somewhat strange to note the fact that public work is so economically done as to be less than that of private persons.

We allude to the cost of dredging, in which a great reduction has been made in the past year, including every item of expense of wages of men, coal, repairs of tugs and dredgers, and ship chandlery. The cost per cubic yard of mud removed from the docks has been 6·89 cents against 7·16 cents the previous year, and 9·02 cents the year before that.

When it is recollected that the State used to pay 30 cents, 24 cents, 20 cents, and that when it got down to 14 cents per cubic yard, it was thought "dirt cheap," it will be seen that the Harbor Commissioners, by economical management, have created a revolution in the dredging business. Since the Board was organized it has spent $622,075 for actual dredging, aside from the cost of construction and repairs of tugs, dredgers, scows, etc.

It is noticeable, too, that this economical work is done with the old style of clam shell dredger, and has not been accomplished by any intricate mechanical wonders like some of the "improved" dredgers. In building dredgers it seems as if inventors tried their best to get as much machinery as possible on to the scow. In fact, in one or two instances, additional scows have had to be called into service to float the machinery.

The old clam-shell seems to keep right on at its work and needs few repairs, while more complicated machines are half the time in the machinist's hands. Inventors who have improved dredging appliances until they are so expensive to build and run that they are laid aside or ignored, will do well to recognize the fact that simplicity in this bulky class of machinery is a most important factor. We have heard of no private dredgers of any style which has accomplished its work as cheap as that done by the Harbor Commissioners. The tugs, dredgers, barges, etc., of the State appear to be kept in first-class order. They are always steadily at work winter and summer. The mud, though soft, has to be carried some distance. It is lifted from the slips between the wharves, deposited in the scows, which are carried by the tugs to the deep waters of the bay channel. This is kept up steadily, the mud being moved from the shoal places at the wharves to the ship channel. The advisability of this action is to be questioned, but, as yet, no effective means have been devised to lift the mud from scows and deposit it on land. When this can be done at a reasonable figure it will, of course, be time to stop dumping mud in our ship channel. The swift current of the bay distributes the mud evenly, and the area is so large that, as yet, no bad effect has been experienced.

Whatever the means have been to accomplish the result of cheap dredging in this bay, our commissioners should be complimented by the public on their success.—*Mining and Scientific Press.*

PRISMATIC GUNPOWDER.

SEVERAL new descriptions of prismatic powder are being prepared at the Royal Gunpowder Factory at Waltham Abbey, for the future experiment of the committees on heavy guns and explosives. The prisms will be of various forms and sizes, and some will be perforated to accelerate combustion. The researches into the properties of prismatic powder have engaged military and scientific men of various nations for many years; but it is only of late that the introduction of air-spaces into the cartridges has given a direction to experiments, and developed the full advantages of the system. Some powders of this description made in Russia and Germany have recently been tried, and the German prisms, which are about an inch long, have been found to be the best yet produced. The Government Works at Waltham Abbey have manufactured some prisms so large as to weigh 4½ oz. each "grain," but this Brobdignagian powder has been discarded as over-stepping legitimate growth, and the qualities about to be tested will probably not exceed 1½ inch in length, or rather more than 1 oz. per grain. There is now very little doubt that in some form or other the explosive material for employment with great guns in the future will be prismatic gunpowder.

DETAILED COST OF A PASSENGER DAY COACH.

THE following, says the *National Car-Builder*, is a statement of the details of cost of a first class passenger day car built in 1879 at the shops of the Kansas City, St. Joseph and Council Bluffs Railroad Co., at St. Joseph, Mo. The car is 46 feet in length and seats 50 passengers. The interior finish is in walnut, butternut, and bird's-eye maple—Eastlake style. The total cost, as will be seen, is $3,775.74; but in consequence of the higher price of material, it is estimated that a car of the same description cannot be built now at the same shops for less than $4,300.

ITEMS OF COST.

Machinists			$14 97	
Blacksmiths			70 58	
Tinners			32 60	
Carpenters			784 30	
Painters			250 07	
Upholsterers			65 00	
Laborers			2 40	
Shop Expenses and Fuel			65 86	
Shop Expenses and Tools			153 24	
Master Mechanic and Assistant			65 92	
				$1,504 94
Wrought Iron	lb.	5,583	$0 03	167 49
" "	"	57	6	3 42
Miller Draw-Bars		2	20 00	40 00
Truck Equalizing Bars		4	....	98 25
Cable Chains	lb.	60	5½	3 30
Cast Iron	"	5,511	2½	137 78
Nuts, Bolts, and Washers	"	718	3	21 54
Hexagon Nuts	"	24	5	1 20
Lag Screws	"	66½	8	5 32
Nails	"	1441½	4	5 78
Spring Steel	"	187	7	13 09
Coil Spring for Trucks	"	8	3 07⅗	24 62
Draw-Bar and Buffer Springs	"	4	1 82	7 28
Elliptic Springs	set	1	....	81 38
Wheels		8	10 75	86 00
Axles		4	9 75	39 00
Brasses	set	116	22	25 52
Air Brakes	"	1	....	103 83
Carriage Bolts	lb.	145	2	2 90
Oil Box Gaskets		8	15	1 20
Pine Lumber	ft.	216½	25 00	5 41
" "	"	351½	40 00	14 06
" Ceiling	"	829	30 00	24 87
Yellow Pine Sills	"	1,470	45 00	66 15
" " Flooring	"	623½	30 00	18 71
Ash Flooring	"	300	40 00	12 00
" and Poplar	"	4,976½	40 00	179 06
Oak	"	1,635½	26 00	43 04
Walnut—Fulton	"	478	26 00	12 44
" Chicago	"	780½	50 00	39 02
Elm	"	120	30 00	3 60
Butternut	"	230	40 00	9 20
Bird's-eye Maple Veneer	"	155	45 00	6 98
Screws	gross	64½	....	39 95
Sheet Iron	lb.	137½	4	3 50
Planished Iron	"	155½	12	13 86
Charcoal	"	37½	6	2 25
Tin—Sheet	"	179	18	32 22
Solder	"	34	14	4 76
Galvanized Iron	"	60	12	7 20
Copper	"	12½	26	3 25
Sheet Lead	"	6½	7	45
" Brass	"	1	45	45
Lead Pipe	"	17	6	1 02
Mineral Paint	"	59½	10	5 95
White "	"	32	8	2 56
Wood Filling	"	35½	10	3 55
Car Color	"	45½	15	6 83
Yellow Paint	"	30	10	3 00
Green "	"	1	20	20
Tuscan Red	"	3½	20	70
American Vermilion	"	2	25	50
Drab	"	3	10	30
Varnish (black)	"	2	50	1 00
Oil	"	1	20	20
Gold Leaf (books)		2½	45	1 12
Bronze (papers)		2½	25	62
Varnish	gal.	6¾	4 50	30 38
Shellac	"	3⅞	2 20	8 52
Alcohol	"	7·16	2 20	97
Paint Brushes		....	....	1 20
Putty Knives		1	25	25
Glass (lights)		37	64	23 68
" (orange)		14	78	10 88
" (ruby)		14	60	8 40
Putty	lb.	8½	3	25
Decorated Head Lining		1	....	83 32
Head Lining Nails		500	....	1 25
Seat Springs		24½	...	52 13
Tow	lb.	200	3½	7 00
Hair	"	125	30	37 50
Sheeting	yds.	70	8	5 60
Cotton Duck	"	30	70	21 00
Plush (scarlet)	"	64	2 12½	136 00
" (green)	"	30	1 81¼	54 38
" (nails)	gross	1¾	65	96
Mattress Twine	balls	2	90	1 80
Linen Thread	"	2	10	20
Tacks	papers	72	5	3 60
"	"	6	....	77
Trunk nails	"	1½	20	30
Seat Arm		50	14 00	14 00
" Rivets		51	6	3 06
" Back Moulding		50	....	29 43
" Locks		50	67½	33 75
Machine Screws		50	1	50
Brass Wire Cloth	ft.	55½	45	24 97
Sash Locks (right and left)		56	for	23 52
Sash Locks		28	"	8 84
" Catches		28	"	11 76
" Stops		68	"	4 50
Blind Lifts		68	"	6 12
Sash Locks Drop		2	36	72
Brass Tubing	lb.	5	5½	28
Sash Springs		140	7	9 80
Lamps		4	for	14 16
Match Strikes		4	42	1 68
Lamp Rings		4	42	1 68
Baggage Racks		26	....	55 75
Notice Plates		2	2 25	4 50
Bell Cord and Couplings		1	1 70	1 70
" " Bushings		4	20	80
" " Hangers		3	1 75	5 25
Coach Latches		1	4 00	4 00
" "		1	7 50	7 50
" Locks		2	3 25	6 50
Saloon "		1	3 25	3 25
" Latches		1	3 50	3 50
" Handles		1	1 00	1 00
" Hoppers		1	8 50	8 50
" Urinals		1	4 75	4 75
Coach Hinges	pair	3	2 25	6 75
" "	"	3	....	1 95
Brass Butts	"	1	12	12
Strap Hinges	"	2	6	12
Cooler Cocks	"	1	1 25	1 25
Waste	"	1	85	85
Brass Unions	"	1	40	40
Clout Nails	papers	6	10	60
Nails	lb.	2½	8	20
Tinned Nails	"	1	....	5
Tacks	"	5	5	25
Iron Wire	"	10	8	80
Cotter Keys	doz	3	....	25
Split Keys	"	½	....	3
Head Light Chimneys		1	....	10
Candles	lb.	1¼	15	17
Charcoal	bbls.	3½	15	53
Matches	box.	1	5	5
Stove Polish		2	5	10
" Brush		1	....	10
Pure Rubber	lb.	½	....	25
Waste	"	5	8	40
Rags	"	31	5	1 55
Chamois	"	1	....	38
Engine Oil	galls.	1	16	16
Sheet Zinc	lb.	50	8	4 00
Blossburg Coal	tons.	1½	8	12 00
Gas-pipe Fittings		....	....	13
Sand Paper	sheets.	433	1	4 33
Glue	lb.	34	16	5 44
Filters		4	....	90
Brads	papers	31	5	1 55
Total cost				$3,775 74

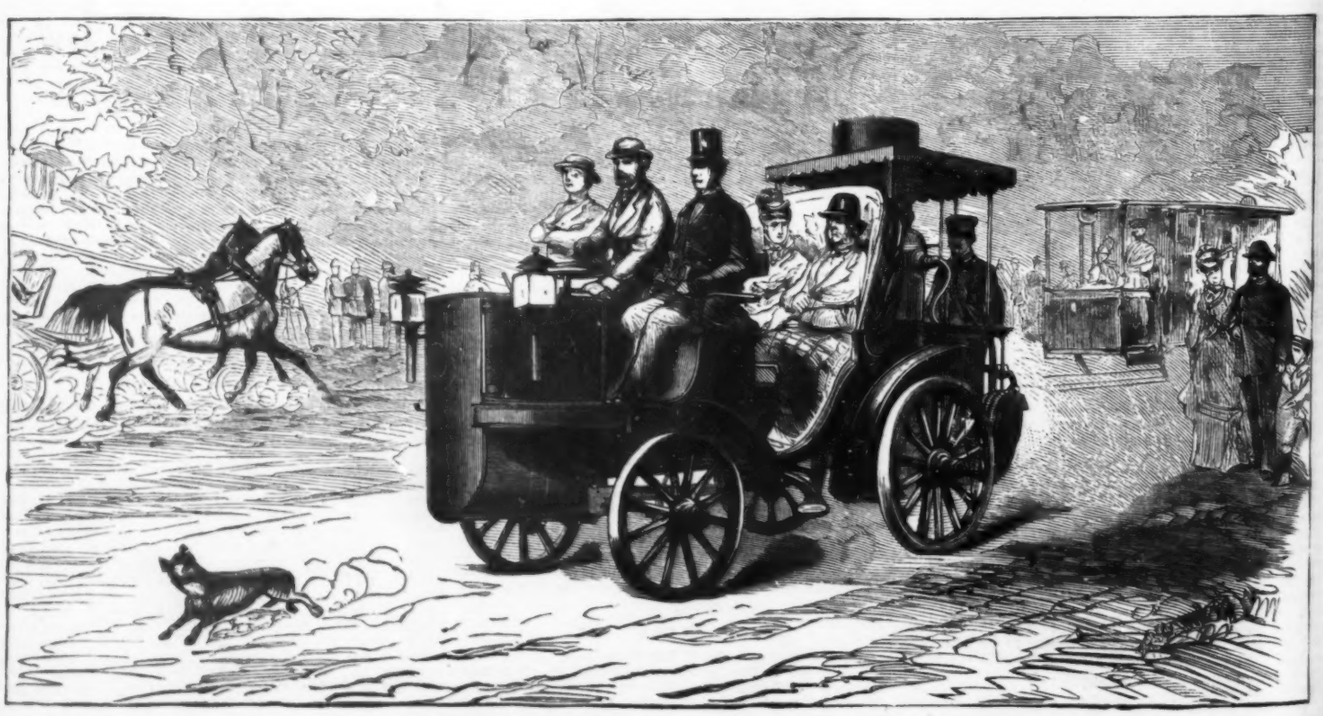
IMPROVED STEAM CARRIAGE.

A GREAT many steam wagons and carriages have been devised and built for transporting loads on our ordinary highways without tracks, but although some of the devices were masterpieces of ingenuity, the practical results obtained were never perfectly satisfactory. Walter Hancock, the most persistent of inventors and constructors in this line, built a steam phaeton in 1838, and obtained a maximum speed of twenty miles and an ordinary speed of ten miles per hour. Within the last few years the interest in steam wagons has been renewed, and some very successful experiments have been made with them, the trip by M. Schmid, M.E., who traveled from Zurich to Paris, in 1878, on a self-propelling steam fire engine of his construction, being an example. A steam carriage, invented and built by the French engineer Rollé, of Le Mans, and exhibited at the Paris Exhibition of 1878, was an object of more than ordinary interest. Its speed was said to surpass that of any ordinary vehicle drawn by horses. The inventor named his carriage "La Manselle," in honor of his native city Le Mans.

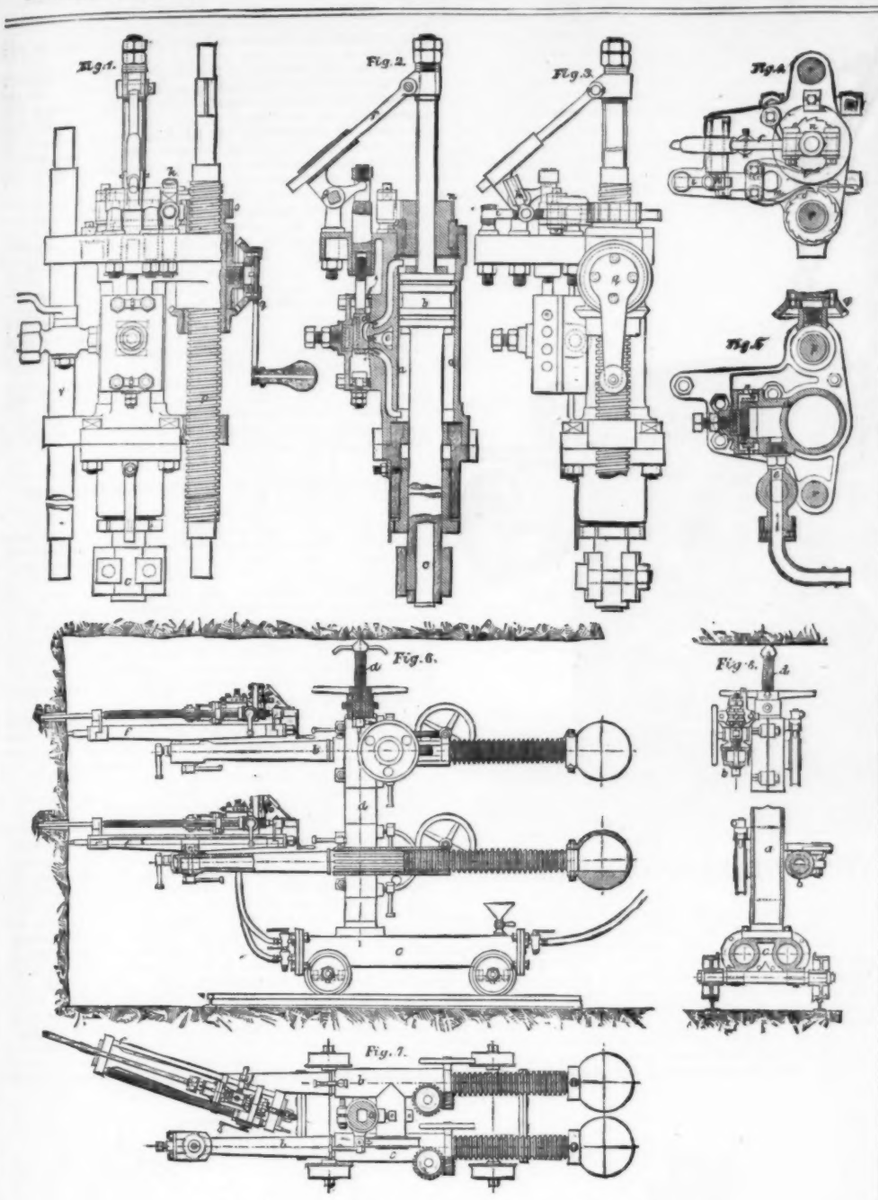
This carriage is shown in the annexed cut, taken from the *Leipziger Illustrirte Zeitung*. The casing in the front part of the carriage contains the driving engine, which is controlled by the engineer seated above it, who also operates the steering gear and the powerful brake levers. The rear axle is driven by spur wheels and chains. The boiler is placed above the rear axle, the coal bins are at each side of the boiler, and the water truck is below the seat of the engineer. Experimental trips have been made with one of these carriages on the road from Berlin to Charlottenburg. The average speed attained, according to the above authority, was eighteen miles per hour, but a maximum of twenty-two miles per hour was reached. Coke was used as fuel, which produced but very little smoke, about eight and a half to ten pounds being consumed per hour. The carriage rounded the curves in an excellent manner, and the entire experiment proved most satisfactory.

IMPROVED ROCK DRILL.

SACHS' machine may be considered as one of those drills in which precision of action, automatic working of all parts, and a minimum of power combined, give high-class results, which can, however, only be obtained at the expense of a somewhat complicated construction. In the machine illustrated opposite all motions are directly connected with the piston, and as soon as the air valve to the cylinder has been opened the different motions are performed in their proper order automatically. The construction will be understood by reference to our illustrations, Figs. 1 to 5. In the cylinder, *a*, moves the piston, *b*, which on its prolonged rod at one end at *c* carries the drill, while coupled to its other end is the rod, *f*, which works the valve, *d*, by means of the bell-crank lever, *g*. The rod, *f*, slides loosely in the sleeve of lever, *g*, see Fig. 2, and the latter regulates the motion of the valve. The valve receives compressed air through the opening, *e*, below the valve, while the exhaust takes place through holes in the side of the valve box. Connected with the bell-crank, *g*, is a lever *h* (see Fig. 3), which works the rod, *i*, guided in two brackets fixed to the cylinder cover; and to this rod, *i*, is attached a crosshead carrying the two pawl springs, *l* and *m* (see Fig. 4), which by their motion turn the ratchet wheels, *n* and *p*. The wheel, *n*, is cast in one piece with the piston and stuffing box (see Fig. 2), and the piston rod being square, with rounded corners, it takes part in the rotary motion, and a slight twist is given to the drill at each stroke. The second ratchet wheel, *o*, forms the nut of the spindle, *p*, and by its rotary motion feeds the



IMPROVED GERMAN STEAM CARRIAGE.



SACHS' IMPROVED ROCK DRILL.

drill up to its work. The teeth on this ratchet wheel are, however, proportioned in such a manner, that the nut, *o*, does not move until the drill has acquired a certain length of stroke, and after this, the feed is automatic. The spindle, *p*, forms one support of the machine; another shaft, *r*, is placed on the other side, and by means of a set of bevel wheels on the nut and a hand crank the drill can be rapidly withdrawn after the hole is drilled. By means of the two guides, *p* and *r*, the rock drill can be fixed to a framing, such as is used for tunneling, and of which we also give illustrations in Figs. 6 to 8, as seen above. The requirements of these portable drill frames are, that they shall hold one or more drills in such a manner that the latter can be turned in any direction without much waste of time and labor, that the frame can be rapidly and firmly fixed in position, and easily removed after the holes are drilled. Figs. 5, 6, 7, and 8 represent one designed to carry two rock drills. It consists of a small four-wheeled truck, *c*, built up of two cylindrical vessels, one of which carries water for washing out the bore holes, the other compressed air for working the drills; both reservoirs are constantly connected by means of flexible hose to larger reservoirs, and at their front end carry the connections to supply the drills also by flexible hose. This truck carries a vertical cylindrical column, *a*, to which are fixed the supports, *b b*, for carrying the drills. The truck itself is fixed in position by the screw, *d*, while each support carrying a drill has a point, *f*, which fixes itself in the rock and steadies the machine. The rack and pinion motion for setting up the drills to their work will be easily understood by reference to the illustrations. All set screws are fitted with independent handles, and the whole is a thorough workmanlike job. The Humboldt Company of Kalk near Cologne are also building frames for carrying four or six rock drills for large tunneling work, and it is, of course, understood that these frames will take either the Sachs or Brossmann machine.—*Engineering.*

MULTITUBULAR GAS BOILER.

WE have had occasion of late to notice the practical advances made in the construction of boilers in which gas is utilized as the source of heat. The most recent example which has come under our notice is shown in the accompanying engravings, which represent a boiler for hot-water apparatus to be heated by gas. The simplicity of its construction will be obvious upon reference to Fig. 1, which shows the internal arrangements. At the bottom of the boiler short lengths of iron pipe are laid in a transverse direction, pierced on either side, for gas jets. Over these several parallel rows of copper tubes are fitted lengthwise, one above the other, into two circulating boxes, or waterways, which form the sides of the boiler, and into which the connections are made, the whole being neatly inclosed in ornamental castings and wrought-iron casing. The gas enters the boilers through an atmospheric burner, giving the most intense heat possible for the amount of gas consumed. The copper tubes are so thin as very readily to conduct the heat to the water, and yet are sufficiently strong to resist any reasonable pressure to which they are likely to be subjected—every boiler being tested by hydraulic pressure to thirty pounds per square inch before leaving the works of the manufacturers, Messrs. Hartley & Sugden, of Halifax, Yorkshire. Fig. 2 of our engraving shows how this boiler may be attached to single or double coils, or to single flow and return pipes. Wherever this gas boiler has been fixed with a full and steady supply of fresh air and good draught, it is reported to work most effectively, and to provide that great desideratum, an economical heating apparatus, requiring scarcely any attention when once lighted, giving off no smell and making no dirt.—*Iron.*

A TUBE EXHIBIT.

THE accompanying illustration gives some idea of one of the most tastefully and effectively arranged trophies in the Dusseldorf Exhibition. It comprises the chief part of the collection of tubes exhibited by the well-known firm of J. P. Piedboeuf & Co., of Oberbilk, near Dusseldorf, the tubes made by whom have not only a large sale in Germany, but their superior quality has enforced their adoption for locomotive and other work in this country. The tubes are made of the best iron, are twice welded, and drawn over mandrels and through dies. In the Dusseldorf Exhibition, tubes so made are shown from a little over one millimeter to about

twelve inches in diameter. The trophy, it will be seen, is constructed of tube and fire-box plates for the pedestal and capital. The base, die, and cornice of the pedestal consist of one flanged fire-box plate and two tube plates, while the capital consists of similar parts of boilers, all of which are pressed from flat plates by Piedboeuf's stamping machinery as used to some extent in this country. The entablature is of wood, as no parts of boilers would come in for representing this. The tubes forming the column are about sixteen feet in length, and bent to the curvature necessary for the optical preservation of a true form of the column. The trophy has a very fine and striking appearance not conveyed by a small engraving.—*The Engineer.*

FIG. 1.

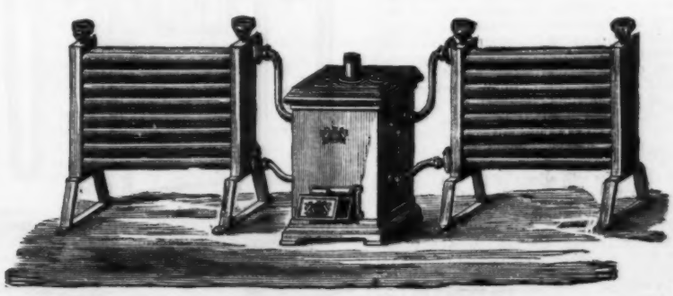
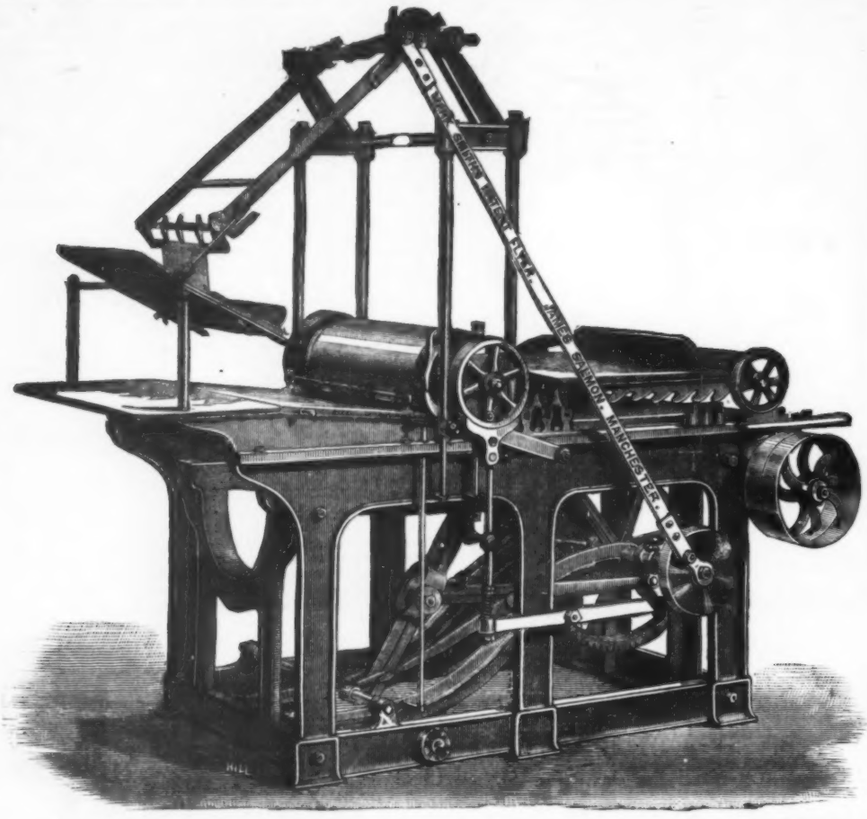


FIG. 2.

IMPROVED MULTITUBULAR GAS BOILER.



IMPROVED TAKING-OFF APPARATUS FOR PRINTING PRESSES.

IMPROVEMENT IN PRINTING PRESSES.

AN ingenious but simple taking-off apparatus attached to a "Reliance" printing machine was exhibited at the recent Exhibition of Printing Apparatus by Mr. James Salmon, of 12 Parsonage, Manchester, by whom it is made under Mr. M. Smith's patent. By reference to the accompanying engraving it will be seen to consist of a pair of arms carrying a gripper blade and gripper fingers at their lower ends, and to which angular reciprocating motion is imparted by the crank and coupling rod at the side of the machine. To the end of the spindle carrying the gripper fingers, which are closed by a spring, is a short bent arm. This short arm at the end of its stroke comes in contact at the delivery table with a projecting bar, which stops the upward motion, though the main arms pass upward a little higher. The gripper fingers are thus opened and the sheet delivered. For the reception of the sheet at the cylinder the grippers are opened by the contact of the small roller against the projection near the end of the cylinder, and the sheet, having entered between them, the gripper closes immediately the arm recedes in the commencement of the upward stroke. The bar affixed to the delivery table is adjustable as to position, so that the moment of release of the sheet is easily altered. The apparatus will take off sheets of any size, and can be fitted to almost any machine without removal.—*The Engineer.*

IMPROVED POWER PRESS.

WE illustrate here a new arrangement of power press, patented, and now being constructed by Messrs. Thomson, Sterne & Co., of Glasgow. The press consists of the usual base and top plates, and columns, constructed to take in the necessary heights and widths, as in other presses, while the pressure is applied by means of the well-known combination of two pairs of toggle levers with a horizontal right and left screw spindle. The upper ends of the upper toggle levers are jointed to the top stationary head of the press, while the lower ends of the lower toggle levers force down the top platen on the substances or articles to be compressed when the screw spindle is turned in the direction to draw together or straighten the toggle levers. The upper platen is fixed to the bottom ends of two long frames, which pass vertically through guide slots in the fixed head, and which have formed on their inner faces near each edge a series of sockets to receive trunnions on the bottom ends of the lower toggle levers. The platen and its followers are counterbalanced by means of ropes or chains passing over pulleys to counterweights, and the platen can be easily raised or lowered to set it in any position for starting a pressing operation according to the depth of the substance or article placed beneath it, as the lower toggle levers can be made to engage with any of the sockets of the platen followers. Also after the platen has been forced down to the extent corresponding to one movement of the toggle levers, a rod may be passed through a hole in the fixed head and through the platen followers so as to hold the platen, while the toggle levers are screwed outward and made to engage with a higher part of the followers. Then on the toggle levers being screwed inwards again, a further descent of the platen is obtained, and this process may be repeated as often as the vertical height of the press will admit of it.

In order to prevent unequal action of the toggle levers on the opposite sides, the internally screwed blocks to which the toggle levers are jointed have upper and lower links jointed to them, and the links at one side are jointed to those at the other side at middle positions above and below the blocks and screw spindle. These middle points of the links are fitted to work in vertical guide grooves formed on the insides of the platen followers, and the arrangement is such as to prevent the screw spindle from deviating from its proper horizontal position.

Instead of the bottom plate being stationary as in other toggle levers and other positive action presses, it is fitted with an elastic bed consisting of steel springs or Sterne's patent junction rubber springs, or any other kind of spring. These springs are, as shown in Fig. 2, placed in the bed of the press and support a yielding platen. This elastic medium may either be in the bed of the press or in the head as found most suitable, and an index gauge like that on a spring balance can be fixed on the elastic bed that will serve to indicate the pressure actually being applied to the press, so that the operators can stop the action as soon as the pressure known to be sufficient for the purpose in view is attained.

During the pressing operation the elastic bed prevents any sudden strains from taking an injurious effect. It also maintains the pressure almost to the full amount for a long time after the movement of the toggle levers has been stopped, notwithstanding the yielding or contracting of the substances or articles being pressed, whether such contraction be due to cooling or to the exudation of oil or other fluid, or to other causes.

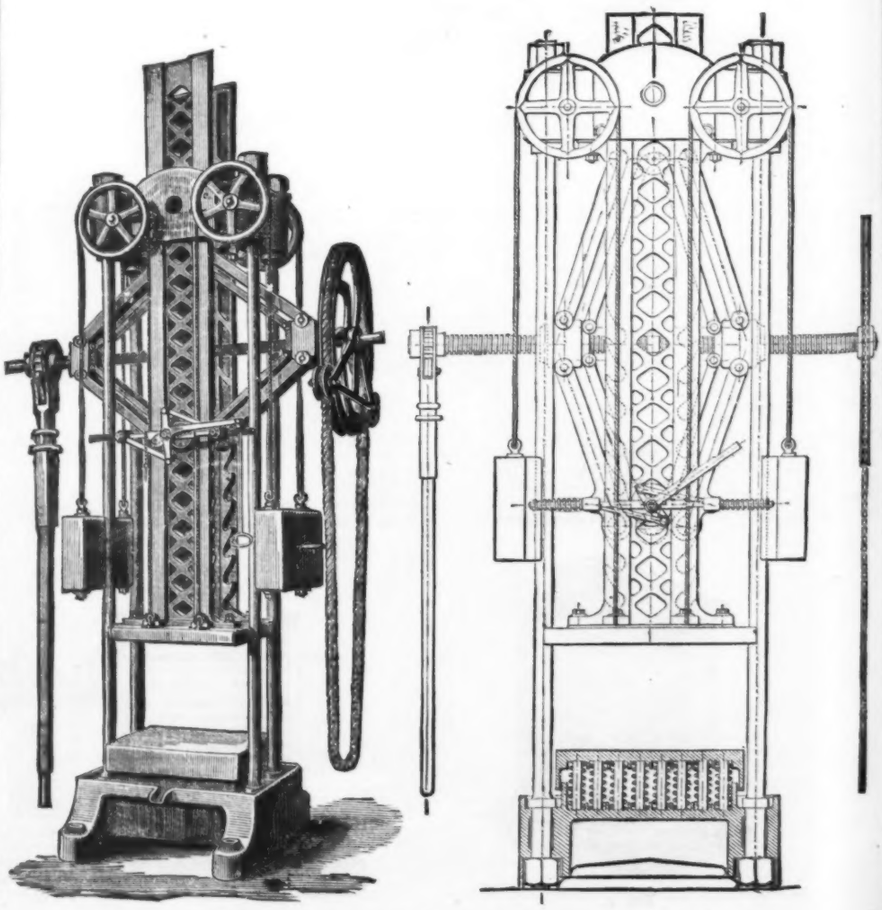
The press is fitted with a rope pulley on the screw shaft for the quick out-and-in motion of the levers, the hand rope being kept on the pulley by small rollers hung in a light frame swinging on the boss of the rope pulley, as shown in illustration; this prevents the hand-rope ever coming off and gives the rope a better grip on the pulley. On the other end of this screw is fixed a ratchet with pawl and long lever for putting on the heavy pressure on the press. The lower arms of the toggle joint are thrown out of and in gear by a simple arrangement which the operator works with one hand while with the other he can work the rope pulley.

The press, as illustrated, has a lift of 5 ft., and the pressure of 150 per square inch can be executed by hand. The arrangement of the elastic bed can, of course, be applied to any existing positive press. The arrangement promises to be an exceedingly useful one.—*Engineering.*

IMPROVEMENTS IN SPINNING MACHINERY.

MR. J. NORTHROP, Keighley, Yorkshire, is the author of an invention relating to spinning, twisting, and preparing machinery, which aims at running the bobbins and spindles employed at such a varying rate of speed that the yarn or roving is delivered on to the bobbins from the fliers at an equal tension throughout the length of the traverse. The *modus operandi* is as follows: A loose collar, having one or more pegs that fit into corresponding holes formed in the bobbin flange, is placed on the ordinary spindle and resting on the lifter. At the back of each spindle is placed another revolving spindle, at the top of which is a wharl covered at the circumference by a ring of flexible material, such as India-rubber.

This invention will be more easily understood by referring to the drawings opposite, in which Fig. 1 is a front elevation, and represents such portions of a spinning frame as are required to describe the improvements; Fig. 2 is a cross section of the same; Fig. 3 is a detail of lever and worm for adjusting the altitude of the bottom lifter plate; Fig. 4 is a sectional detail of the back spindle footstep and shoe. We will describe the improvements as applied to one spindle, all the others being fitted in the same manner. In Fig. 1 two spinning spindles and two rear additional spindles are shown, the latter being the distinguishing feature of the invention. On to the ordinary spindle, and resting on the ordinary lifter plate, A, the loose collar or tube, B, is placed, with one or more pegs that fit into corresponding holes in the bobbin flange. At the rear of the spindle another revolving spindle, C, is mounted, and near the top of this spindle is a wharl, D, connected by a feather so as to turn with it while the spindle will slide easily through. The circumference of this wharl is covered by a ring of flexible material, which is in contact with the circumference of the tube flange or bobbin flange, B. Near the bottom of spindle C, is secured another wharl, D^1, similar in construction to the wharl, D, but not sliding, the circumference of which is in contact with the sliding cone, G, which rotates with the



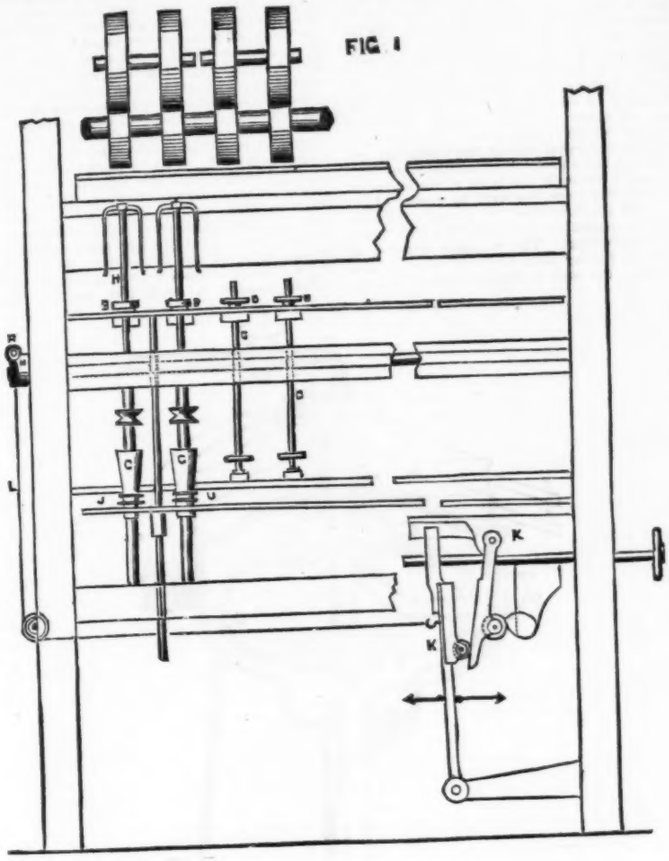
POWER PRESS WITH ELASTIC BED.

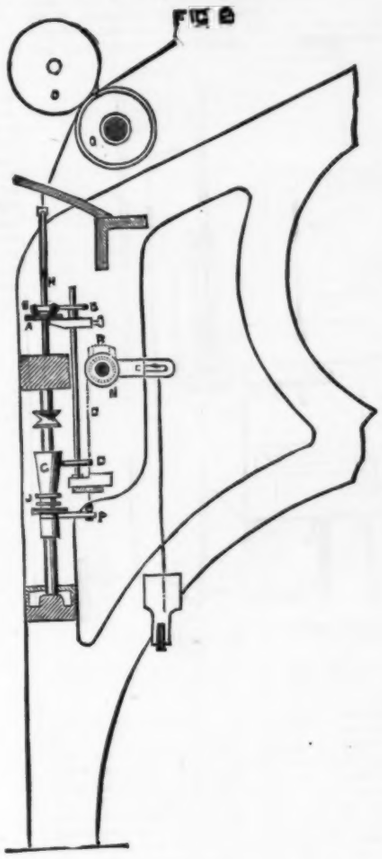
ordinary spindle, H, driven in the usual manner. The cone, G, rests upon tube, J, which is screwed into the bottom lifter plate, J^1. By screwing this tube, J, the cone, G, can be adjusted to the exact height to suit the drag on the fiber that is being manipulated. The top lifter plate, A, is regulated by the ordinary lifter, K, in the usual manner, by which the bottom lifter plate, J^1, is also regulated, but in the following manner: A chain, L, is attached to the movable arm, K^1, and to the lever, M, placed on the shaft, N, on to which is secured opposite to each lifter spindle, E^1, a pulley, N^1, to which is secured a chain, O, that is attached to the bracket, P, on the top of which rests the bottom lifter plate, J^1. The arm, K^1, in moving backward and forward in the direction of the double arrow will cause the shaft, N, through the fiber passing through the machine. This lever is placed loosely on shaft, N, and has projecting lugs, M^1, between which is mounted a screw worm, R, which gears into the worm wheel, R^1, secured on the shaft, N. By turning R on its axis the lever remains the same, but the position of the shaft, N, is altered, the pulleys, N^1, secured thereon letting off or taking up round the circumference some of the chain, O, thus lowering or raising the lifter plate, J^1, and cones, G, as the case may be.

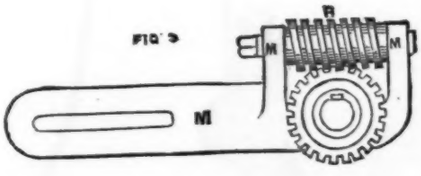
Fig. 4 shows the arrangement for keeping the circumference of the wharls, D^2, in contact with the cone, G, which is accomplished by means of the spring, Y, compressed between end of shoe and spindle footstep.

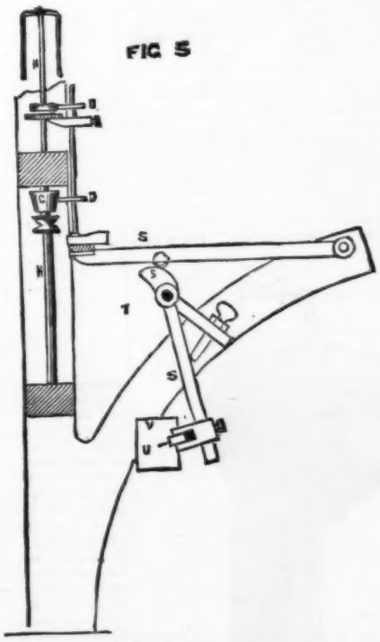
Fig. 5 is a cross section of spinning frames showing the cones, G, which are by this modified arrangement fixed to the spindles and placed above the ordinary spindle driving wharls. The back spindle, C, and wharls, D and D^1, are the same as before described; but in this case the bottom wharl, D^4, travels up and down the cone, G, to obtain the varying speed imparted to the bobbin on the spindle, H. This is accomplished by mounting the series of spindles, C, upon the bar, S, which is supported by levers, T, and the raising and lowering of these spindles is effected by cams, S^1, secured upon shaft, T^1. The bar, S^2, is loose on the shaft, and toward the end of this bar is secured the bracket, U, containing pulley, U^2, which is in contact with plate, V, set at an angle with the front of spinning frame and attached to the lifter arm, K^1. This lifter arm oscillates backward and forward in the direction of the double arrow, shown in Fig. 1. The angular face of plate, V, being in contact with pulley, U^2 raises and lowers the arm, S^1, which actuates the shaft, T^1 through the lever, W, secured to it, and causes the cams, S^2 to regulate the altitude of the bottom wharl, D^4, in relation to the circumference of the cone, G, thus running the back spindle and connections at a varying rate of speed. By adjusting the screw, W^1, in the lever, W, the altitude of the wharl, D^4, in relation to the cone, G, is regulated to suit the amount of drag required to be put upon the fiber that is being manipulated.

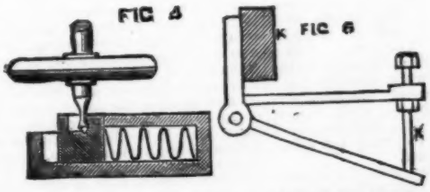
Fig. 6 is a detailed plan showing the angular plate, V, and attachments to oscillating arm, K^1; by the regulating screw, X, the angle of plate, V, is altered, causing the back spindle, C, and the wharl, D^4, to travel more or less up and down the cone as the case may be.—*Universal Engineer.*











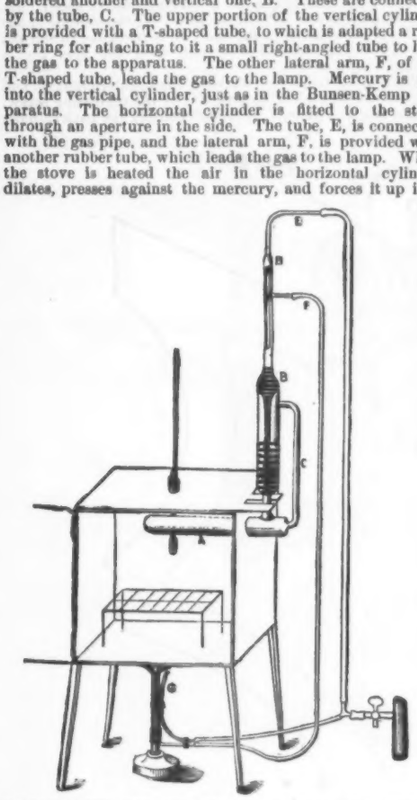
IMPROVEMENTS IN SPINNING MACHINERY.

OLD wine, says Macagno, owes its mellowness more to the increase of glycerine than to a decrease of tannin in the liquid. The "keeping" of the wine, he maintains, depends upon the proportion the alcohol bears to the tannin.

THE *Engineering* says that overhead telegraph wires are becoming again so numerous in London that the decapitations which were so prevalent by their breakage a year ago may be expected to be repeated. Mid-air wires are unsightly and sometimes untrustworthy, but here in New York they are not very fatal arrangements.

APPARATUS FOR REGULATING THE TEMPERATURE OF GAS STOVES.

THE apparatus figured herewith is the invention of M. Crestl, and is composed of a horizontal closed cylinder, A, fifteen centimeters long by two centimeters wide, to which is soldered another and vertical one, B. These are connected by the tube, C. The upper portion of the vertical cylinder is provided with a T-shaped tube, to which is adapted a rubber ring for attaching to it a small right-angled tube to lead the gas to the apparatus. The other lateral arm, F, of the T-shaped tube, leads the gas to the lamp. Mercury is put into the vertical cylinder, just as in the Bunsen-Kemp apparatus. The horizontal cylinder is fitted to the stove through an aperture in the side. The tube, E, is connected with the gas pipe, and the lateral arm, F, is provided with another rubber tube, which leads the gas to the lamp. When the stove is heated the air in the horizontal cylinder dilates, presses against the mercury, and forces it up into



APPARATUS FOR REGULATING THE TEMPERATURE OF GAS STOVES.

the long arm of the T-shaped tube. In rising, the mercury stops the passage of the gas completely, and consequently the jet which heats the stove is extinguished; but a small metallic tube, G, fixed to the lamp by brass wire, and which communicates with the gasometer, leads a very small quantity of gas, always kept lit, to within a distance of a centimeter of the gas burner. This small jet does not appreciably heat the stove, but serves to relight the gas, when, through a decrease of the temperature, the latter again begins to flow. As will be seen from the figure, it is only necessary to raise or lower the small tube, E, to obtain the temperature desired. The inventor claims that the apparatus works with great regularity, that it is very sensitive, very simple, and quite cheap.

LAVAL'S CENTRIFUGAL CREAM SEPARATOR.

WE figure herewith, from the *Bulletin de la Société d'Encouragement*, an apparatus designed to rapidly separate the cream from milk by the action of centrifugal force—a process which, although by no means new, has never before been realized in a manner that was in all respects satisfactory. This separating apparatus (represented in perspective in Fig. 1, and in section in Fig. 2) is the invention of M. Laval, Stockholm, and is said to be the most perfect machine of the kind that has ever as yet been devised. The whole

FIG. 1.—LAVAL'S CENTRIFUGAL CREAM SEPARATOR

apparatus is supported by a cast-iron standard, *a b* (see Fig. 2), the base of which is bolted at each of its four corners to the floor-planking. The cylindrico-spherical vessel, *c*, cast in one piece with the standard, is provided with a remarkable cover, and is traversed vertically by the rotary axle of the apparatus. The milk enters through the tube, *d*, the bent extremity of which is supported by the arm, *e* (not shown in Fig. 1), and the latter is pivoted on a projection from the surface of the vessel, that it may be swung to one side when it becomes necessary to remove the cover. The rotary axle, *f g h*, is composed of three parts, as follows: (1) a tube, *f*, forming the upper extremity, joined to and communicating internally with another and horizontal tube, *f'*; (2) *g*, an intermediate cylindrical shaft; and (3) a terminal shaft, *h*, which is held in place by a flange cast in one piece with the standard. The rotary axle carries a steel spheroid, *i*, which is surmounted by a cap, *j*, which, in its turn, is surmounted by a vertical collar open above. In the interior of the spheroid there is a bent tube, *k*, which communicates at its upper part with the cap, and, at its lower, with the interior of the spheroid by means of a series of apertures. Within the collar of the cap, *j*, and immediately surrounding the part, *f*, of the axle, there is a second collar, *l*, which is connected below with the spheroid. Over the cover are superposed two tin vessels, *m m'*. These serve to receive the products separated during the operation, and which flow off through two tubes, *t t'*. The axle is lubricated from the oil-box, *q*, through the tube, *r*, the excess of lubricant being led away from the axle by means of the inclined piece, *s*. On the lower part of the axle is fixed a pulley, *n*, over which passes the belt or cord which transmits motion to the apparatus. The machine operates as follows: The tube, *d*, having been properly centered, and the axle being rotated, the milk is allowed to flow into the

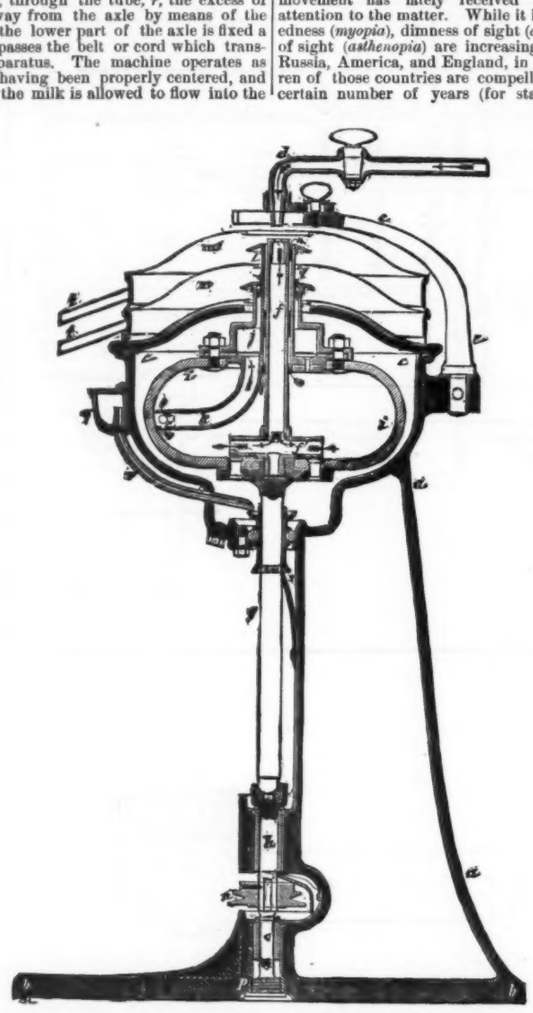


FIG. 2.—SECTION OF CREAM SEPARATOR, ONE-FIFTH ACTUAL SIZE.

spheroid through the tubes, *f f*. In measure as the whey and cream separate, the former flows through the tube, *k*, and the cap, *j*, into the vessel, *m*, from whence it flows out through the tube, *t*. The cream ascends into the space between the axle and the collar, *l*, and then enters the vessel, *m'*, and flows out through the tube, *t'*. The arrows with a single point turned downward show the direction taken by the milk on entering the apparatus. The arrows with a single point turned upward show the direction taken by the whey; and those with two points show the direction taken by the cream. The apparatus needs scarcely any attention; the motor once set in operation, and the inlet cock opened, the machine will take care of itself. It is very easily and very quickly cleaned, the operation requiring but a few minutes, with the use of a gallon of water.

With a spheroid ten inches in diameter, rotated at a speed of 6,000 revolutions per minute, twenty-eight gallons of milk per hour may be tested. The apparatus may be driven by horse-power. From experiments already made it has been ascertained that the milk treated by this apparatus gives about 5 per cent. more butter than the same milk treated by the ordinary process in vogue. In France (department of the Eure) M. A. Bacquet, who formerly used from three to three and-a-half gallons to the pound of butter, now, by the use of the apparatus under consideration, employs only two to two and three-quarter gallons to obtain the same amount.

Finally, the separator possesses still another advantage—that of separating foreign matters from the milk. On this subject, a very curious experiment was tried by M. Bacquet, who mixed lamp black with fresh milk and put this nearly black liquid into the apparatus. The result was that both the cream and the whey came out perfectly white. On examination of the apparatus the lamp black, with a few other impurities, was found firmly adhering in a thin layer to the inner surface of the separator. Of the accompanying figures, Fig. 2 is drawn to a larger scale than Fig. 1, in order to better show the details of construction

SCIENTIFIC FENESTRATION.

SCIENTIFIC fenestration, that is, the ascertainment of a trustworthy rule to regulate the forms and dimensions of windows, and their number and position, in relation to the light required in the interiors of buildings for various purposes, is a matter of almost insuperable difficulty. The text books of architecture, indeed, say that nothing seems so much to disallow of general law; and, in default thereof, the architect is usually advised to err on the side of providing an excess of light, because it is always easier afterward to diminish than to increase it. Although the difficulty is thus got over in a rough and ready, practical way, a certain rule would be none the less valuable, if it were only to supply an admitted deficiency in architectural science. But the subject assumes very much higher importance when we are assured by all the eminent physicians of the day that defective eyesight is largely on the increase among the people of this and other countries, and that, among other causes, the most powerful and most clearly ascertained is the commonly injurious arrangement of the window lights in rooms wherein we live and work. These remarks apply more particularly to school rooms, and the impetus which the educational movement has lately received has attracted increased attention to the matter. While it is found that short-sightedness (*myopia*), dimness of sight (*amblyopia*), and weakness of sight (*asthenopia*) are increasing generally in Germany, Russia, America, and England, in proportion as the children of those countries are compelled to attend school for a certain number of years (for statistics see a paper on "School Hygiene," by Dr. F. F. Lincoln, of Boston, Mass., in Dr. Buck's recent "Treatise on Hygiene and Public Health," vol. ii., pp. 605, 606), we are assured, at the same time, that the percentage is much greater in schools where defective window arrangements prevail, than in others; and there can be no doubt that the same causes produce similar results, although in less degree, from the greater sensitiveness of the eye in childhood, in buildings for adults. Perfect vision is, in fact, a rarer blessing than those who enjoy it are apt to suppose; and those who have it not fail to realize how much of the defect is due to an imperfect regulation of the light by which they work. Excess or deficiency of light, cross lights, light falling at an improper angle, and light reflecting various colors, are all, in their degree, more or less injurious to the eyes, and it is the business of the architect to get as near an approximation to a certain rule as possible (we confess at the outset that an absolutely certain rule has not, as yet, been devised), to illuminate his buildings so as to provide against all these. The light admitted into our buildings requires regulation in three main respects, viz., (1) Quantity; (2) Angle of incidence; (3) Quality.

(1) *The Quantity of Light.*—The main difficulty in regulating this arises from the variations of natural light itself. Artificial light can be always exactly measured and regulated. It is a well-ascertained law that the illuminating power emanating from any source of artificial light always diminishes in intensity exactly as the square of the distance from the source of light increases; and hence, we can always regulate the quantity which shall fall upon an apartment, or any part of an apartment, from any given number of sources, and by the very simplest means, we can also regulate its quantity and its angle of incidence. But not so with natural light. Practically speaking, all points of the

earth's surface are at an equal distance from the source of light, the sun. In the open air, the quantity of light is diminished only by shadows, such as those of clouds, trees, or buildings, and by vapors in the atmosphere; and it is seemingly increased by reflection, and by the apparent height of the sun in the sky, according to which it must pass through a greater or less thickness of the atmosphere, which absorbs a part of the light in proportion to itself, and leaves a greater or less quantity to fall upon a given spot. The light falling directly upon every spot is thus a quantity varying with the sun's course in the heavens at every moment of the day; and this fact renders any rule founded upon the direct light of the sun absolutely impossible. But an average law is not equally impossible. The atmosphere is, in itself, a great reservoir (so to speak) of light, absorbing a comparatively small portion as it comes from the sun, and radiating the rest in every direction. Hence a sufficient approximation to a general law may be attained by assuming the sky (that is, strictly speaking, the atmosphere) to be a hemisphere, uniformly illuminated in all its parts, and then calculating how much of its light will enter an aperture of given dimensions, and in a given situation.

The very best light possible has been proved, experimentally, to be that derived from a horizontal skylight, or from a simple aperture in the roof. The reason for this is, that the light is poured into the apartment from every part of the great natural hemisphere of light by which it is surrounded, no appreciable quantity being lost by absorption, reflection, or refraction. A crucial example of the efficiency of this mode of lighting is found in the Pantheon at Rome. This ancient building has a clear internal diameter of 142 ft. 6 in., with a height of 74 ft. to the springing of the semicircular dome, and may, therefore, be taken in round numbers, to inclose a space of about 1,934,460 cubic feet. But the whole of this vast space is most efficiently lighted by one single aperture in the crown of the dome (commonly called the eye), which is only 27 ft. in diameter, and has, therefore, an area only of a little above 573 ft.; whence it follows, that each superficial foot of this aperture efficiently illuminates no less than about 3,480 cubic feet of space. Apart from all considerations of climate, this one example clearly shows the wonderful superiority of vertical illumination where it is possible. But this kind of window is possible only to a very limited extent. In most cases, light has to be admitted through windows in vertical walls. In considering the quantity of light such windows will admit, it is, of course, necessary to treat the question, in the first instance, as if an entirely unobstructed space were in front of the aperture, and to leave the effect of obstructions for after treatment. Now, it is found that the rays of light which enter such an aperture are very considerably modified by the degree of obliquity with which they strike upon its surface; or, what is the same thing, by the angular distance between the horizon and the zenith from which they proceed. A ray, for example, that strikes horizontally on a window, as in the case of the sun rising or setting exactly opposite to it, will arrive at the far end of the interior with the same degree of intensity with which it leaves the glass, so far as we can appreciate it by our sensations. But, on the other hand, rays that proceed from near the zenith strike the surface of the window very obliquely, and with a very great diminution of illuminating effect. The reason of this is, that the breadth of a beam of light entering horizontally is fully equal to that of the aperture, and it, therefore, loses none of its illuminating effect; but the breadth of an oblique beam, and, therefore, its illuminating effect, is diminished in proportion *to the sine of the angle at which its rays are inclined to the aperture*. When the angle is small, its sine is small, and the lighting power is, therefore, insignificant. The angle at which a beam of light falls upon a perpendicular aperture is thus the measure of its illuminating power, and this has been computed with considerable exactness, as shown in the following table:

RELATIVE ILLUMINATING EFFECTS OF EVERY TEN DEGREES OF SKY MEASURED FROM THE ZENITH.

Arcs of 10° each.	Number of rays out of every 100 which the aperture receives from each arc.
Between 90° and 80°	1·5
" 80 " 70	4·5
" 70 " 60	7
" 60 " 50	10
" 50 " 40	13
" 40 " 30	14
" 30 " 20	16
" 20 " 10	17
" 10 " 0	17

In estimating the quantity of light received from a given arc of the sky, according to this table, it must be borne in mind that all those *above* it are to be added to it. Thus the light received at from 70° to 60°=7+4·5+1·5=13, and that from 10° to 0°=100. But these principles and computations are more useful in calculating the question of the effect of artificial obscurations of light, than for establishing the rule of which we are in quest.

If we take the average size of windows practically constructed in most London houses, we shall find, as a common enough example, in an ordinary room, say 20 ft. by 15 ft., lighted by two windows of ordinary height, 3 ft. wide in the glass, with the light received at an angle of 45° all along the front, indefinitely (for example, a ground floor window in a street whose width equals the height of the houses), that the amount of light is barely sufficient for ordinary residential purposes, and this, therefore, is according to the *dictum* of Professor Kerr, an instance of the *standard minimum of necessary lighting*. Proceeding from this point, and taking as standard conditions that the sill of a window is about 2½ ft. from the floor, and the head about 1 ft. from the ceiling, Professor Kerr suggests the following scale of widths of window space with corresponding dimensions of rooms at random proportions, heights being immaterial, and the angle of light being in all cases 45°, as a minimum of domestic light:

Total window space	3 ft.	wide;	room 12 ft.	by	12½ ft.
"	4	"	" 16	"	12½ ft.
"	5	"	" 17	"	14½ ft.
"	6	"	" 20	"	15 ft.
"	8	"	" 20	"	20 ft.
"	10	"	" 25	"	20 ft.
"	13	"	" 30	"	20 ft.

That is to say, in ordinary cases about 1 ft. of window-width (of standard height) to 50 superficial feet of floor with the lighting intercepted at 45° along the front indefinitely. Professor Kerr adds that it seems of little moment what may be the shape of the room, or the position of the windows, and in this we hardly agree with him. Every ray of light that enters an apartment is deflected from its path by entering, and again by leaving the glass of the window, and for this reason a much larger quantity enters the part of the room nearest the window than reaches the farthest part of the room, and this quantity is in a great degree in proportion both to the size of the window and the position of the observer. Hence we naturally move our book and paper nearer to the window as daylight diminishes. If the problem be as it really is, how to illuminate the apartment uniformly, that is from near the window to the farthest point from it, at the usual height of an observer's eye, seated or standing, say, from 3 ft. to 5 ft. 6 in., we find the position and shape of the windows of great importance. Rays cast from below the level of the eye, as from a window near the floor, not only strike upward to the ceiling and fail to light the room perfectly, but are positively injurious to the organs of vision. If any one wish to test this, let him only try to read with a lamp placed on the floor. The eyes of mankind are constructed with brows and eyelids to shade them from above, whence light naturally comes, but none to shade them below. By all means, therefore, let no windows be made down to the floor, but always from 2½ ft. to 3 ft. from it at the least. In rooms where it is not desired to look out from the window, even a greater height would be as well. The best light is always that which comes in from near the ceiling. Artists prefer to work by a light from the perpendicular part of a lantern in the roof, and this is also the best light for picture galleries and museums. These two facts, viz., that the worst light is from the bottom of a window and the best from the top, lead us to a principle as to shape. If we compare two windows, each containing, say, 40 ft. superficial of glass, the one 15 ft. high by 2 ft. 8 in. wide, and the other 10 ft. high by 4 ft. wide, one might suppose the illuminating effect to be the same. But it is not so. The first window would reach from the floor to the ceiling, the second from the ceiling to within 3 ft. or 4 ft. of the floor. Now, all the light below this level in the first window is practically wasted, and the second admits more useful light in the proportion of 40 to 28·6.

In the case of an apartment, long as compared with its width, it is found in practice that it is more effectually lighted by windows at either of the narrow ends than if the same area of light were admitted on either of the long sides, and most especially so, if it should happen that on such long side there be a pier, instead of a window in the center of such side. In illustration of this we quote, from Gwilt, the example of the ball-room at Windsor Castle, 90 ft. long, 34 ft. wide, and 33 ft. high. This room is lighted from the northern narrower side by a window nearly occupying the width, and is supplied with an abundance of light. But had the same quantity been admitted from either of the long sides of the room, so many masses of shadow would have been introduced through the interposition of piers, that its effect would have differed most widely from the cheerful and airy aspect it now presents. In default of an absolute ascertained law of proportion between the sizes of windows, and the area of apartments, certain rules have been framed from experience. The practice in ordinary London houses we have just mentioned; the practice of Sir Wm. Chambers was to add the depth and width of the rooms, and take one-eighth part of the result for the width of the window, and Gwilt prescribes 1 ft. superficial in a vertical wall for 100 cubic feet, if the light be placed centrally in a square room, and the building is free from obstructions. Another rule has also been given in the following words: "Multiply the length and breadth of the room together, and that product multiply by the height, and the square root of that sum will be the area or superficial contents of the light required." These are the nearest approximations to a rule yet made, and though practically useful, we have not been unwilling to point out some of the points and difficulties in the way of attaining more completeness, and to set our readers on the task of investigating, and, perhaps, largely assisting in the solution of a very interesting problem.

The subject of scientific fenestration, however, includes much more than a mere regulation of the quantity of light. Its angle and direction are of great consequence to the comfort of the worker and the preservation of his eyesight; and this is a matter wherein the architect and physician should work hand in hand, each learning the other's requirements and appreciating each other's difficulties, so as to arrive at the maximum of possible adaptation of our buildings to the delicate organs of human vision. Space, however, fails us to enter fully into all the wide bearings of this subject, and for the present we must confine ourselves to reproducing, for the consideration of our readers, the latest statement of the requirements of the medical profession in relation to the architecture of windows. Though primarily addressed to the architects of schools, they embody principles adapted to all buildings where men live and work. We compile principally from a valuable paper on "School Hygiene," written by Dr. D. F. Lincoln, of Boston, in the United States. A scholar must have a perfect light in whatever part of the room he sits. The requisites to this end are as follows:

The sill had better be placed 4 ft. above the floor. Light entering at the level of the eyes only dazzles, and is almost useless for illuminating the tops of desks. Make the interior of the room pleasant, and the pupils will not want to look out of the window. The top of the window must come as near as possible to the ceiling. By the use of iron girders it can be brought within 8 in. of it, and this should be required. The reason for this requisition is, that the most useful light for a scholar's purpose is that which strikes his desk at a right angle or something near it. This is furnished, first, by the upper part of the windows; and, second, by the ceiling; hence the propriety of using every means to secure the thorough illumination of the latter—a point which is neglected in most dwelling-houses, churches, and schools. Evidently the heads of the windows must be square, and not rounded or pointed, as is the case in certain picturesque styles of architecture. Neither is a pier of masonry dividing a window desirable. The roof must not project so as to cut off any appreciable light, nor are verandas at all allowable in the quarter whence light is supplied. There must be no wing or projection, no pier or column, in the way of light. These restrictions set a limit to the indulgence of the architect's taste; but they leave room enough within the limit. If projections are forbidden, flat decoration and ornamental brickwork are admitted; and shafts, wide doors, and groups of windows are features which can be seized upon to give a characteristic style to the building, which need be neither ecclesiastical, Hellenic, nor commercial.

The proper position of the windows is tolerably well settled. No window should be placed in front of the scholar, for the light thus entering is worse than wasted, blinding him at his work, and tending directly to produce near sight. Windows on the right are slightly objectionable, as throwing a shadow on the page whenever the hand is used in cipherıng, drawing, or writing. Windows at the back throw the pupil's own shadow on his book; but this is not a serious matter, except for those who sit next a window, and they have light enough, at any rate, while for writing they are extremely well placed, as it is usual to turn partly to the left in this exercise. Windows at the left are entirely free from objection, as far as they can be free. The ideal light should come from over the left shoulder, or the right shoulder if one is sitting up and reading; but if looking over a desk, this is rather inconvenient, and the best is then a very high light from the left, and a little in front. In brief, the rule for placing windows is: *never* in front, *always* on the left; at the back also, if you choose; but not at the right, if you can help it. Light from the left and the back at once does not harm the eye, and practically is quite admissible. the only person to find fault is the teacher; in whose eyes the light will fall directly.

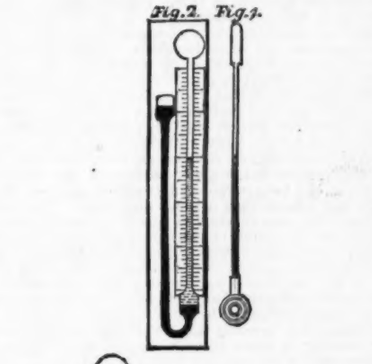
The German authorities agree substantially with these remarks, though they differ among each other in the degree of emphasis with which they forbid the rear and right-hand windows. Dr. Erissmann says emphatically: "The light must be taken from the left side only. A room which cannot be sufficiently lighted from that side is unfit for a schoolroom." English schools are peculiar; and, from the shape of the rooms and the presence of galleries, are often hard to light.

The size of the windows, taken collectively, should equal at least one-sixth of the floor space. Cohn requires one-fifth, or 30 in. to the foot. Less than this will probably be insufficient in many cases. It is also stated by the highest authorities in school hygiene that 300 or 350 square inches of glass are required for each pupil, and this requirement is nearly coincident with Cohn's in the German schoolrooms, which hardly exceed 7 meters in depth. In those of greater depth it would not be nearly enough.—*Building News.*

AIR THERMOMETERS.*

By D. WINSTANLEY.

A THERMOMETER which makes its indications in consequence of the dilatation and contraction of a gas offers several advantages over one which depends on the volumetric variations of a liquid. Gases under constant pressure expand considerably more than liquids do for the same elevation in their temperature. Hence, an air or gas thermometer having the same size of bulb and tube as one in which a liquid only is employed will have a more legible and open scale. Again, a given volume of a gas at



AIR THERMOMETER.

the ordinary barometric tension of the air upon the level of the sea, when compared with an equal volume of a liquid body, requires so utterly insignificant an amount of heat to elevate its temperature through a given range, that a gas thermometer must be enormously more sensitive than one which depends upon a liquid for its expansional effects. And finally, the very equal manner in which gases are dilated under the influence of equal increments of heat is a very strong point in favor of an air thermometer. As constructed by Galileo, the air thermometer unfortunately gave readings which were influenced by the barometric variations of the outer air, a circumstance which has limited considerably its use and application. Happily it is not difficult to construct an instrument which shall be free from this defect. If we take an ordinary mercurial barometer, made after a certain well known pattern, *i. e.*, with a bulb-shaped cistern surmounted by a neck into which we may insert a cork, and if as a matter of fact we *do* insert a cork, obviously that barometer ceases to show the tension of the outer air and is a barometer only to the air inclosed within its bulbous cistern. But as the tension of this air will vary with its temperature, the height of the mercurial column will vary therewith as well; and that which was a barometer will, by the mere insertion of a cork, have become an air thermometer, the readings of which are uninfluenced by the barometric variations of the external air. There is, of course, no reason why the tube of such an instrument should be so little or so much as thirty odd inches long. Neither is it necessary that mercury should be the liquid used. Sulphuric acid, for instance, will answer just as well. It is not even needful that the liquid should be non-volatile at the temperatures to which the apparatus is exposed. The objection which exists to the employment of a volatile liquid in the ordinary barometric column does not here apply; for that depression which the vapor tends to produce in one limb it tends to produce in the other one as

* Paper read before the Physical Society.

well, and so leaves the equilibrium of the liquid undisturbed and dependent only on the expansion and contraction of the "permanent" included air. It is merely needful, then, in this form of air thermometer that the gas inclosed shall be submitted to the definite pressure of an isolated barometric column, and we may employ what liquid and what length of tube we please. We may even construct a veritable air thermometer *without* a barometric column by resorting to some other means of obtaining the definite pressure we require; and to this end the author has employed a vacuous corrugated elastic box similar to those contained in aneroid barometers, but he has used it with the spring inside. This thermometer is shown in Fig. 1. At the bottom we have a rigid box with the elastic one inclosed. Both of course are sealed, and the elastic one is surrounded by the liquid which is to operate as an index, and which rises some distance up the tube in which the indications shall be made, and which tube is surmounted by a bulb of air. This air with a rise of temperature expands and forces down the substance of the liquid column into the space made for its reception by squeezing the elastic box, and with a fall of temperature the reverse of this takes place. The air thermometer which I first described (that with the isolated barometric column) cannot, in the shape in which I have described it, be regarded as having a convenient form, inasmuch as through the greater portion of its length the liquid will never move. Obviously the index of the barometric column will not reach the level of the liquid in the cistern until the air included has ceased its pressure and the rational zero is attained; and the amount of space which marks the range between the freezing and the boiling points of water will have nearly three times as large a space below, devoted for the greater part to readings which will very likely never be observed.

I find, however, a very convenient instrument may be produced if in its construction two liquids are employed, as shown in Fig. 2. There we have a mercurial barometric column. Its cistern is connected with the bulb of air by a long and upright tube. A column of sulphuric acid rests upon the mercury within, and the summit of the barometric tube is considerably enlarged. The tube connecting the barometer cisterns with the bulb of air is comparatively narrow in its bore. In consequence of this arrangement the vertical amount of liquid motion is practically confined to the substance of the lighter columns, and is several times greater in extent than if one liquid only had been used. We are accordingly enabled in this way to make an air thermometer of which the index shall move over pretty near its total length for such natural changes in temperature as we meet with in a given place. Such an instrument was constructed for me in Paris, in 1878. It has hung in the Loan Collection of Scientific Instruments, in South Kensington Museum, for something like a year, and the accuracy of its indications does not seem impaired. The desirability of using colored sulphuric acid as the material of the lighter column will very likely be a matter for remark. I am aware that other experimentalists who have employed it in barometers have found a depression of the column has ensued, and a crystalline deposit has been left on the mercurial surface. It is for me, however, to speak as I have found.

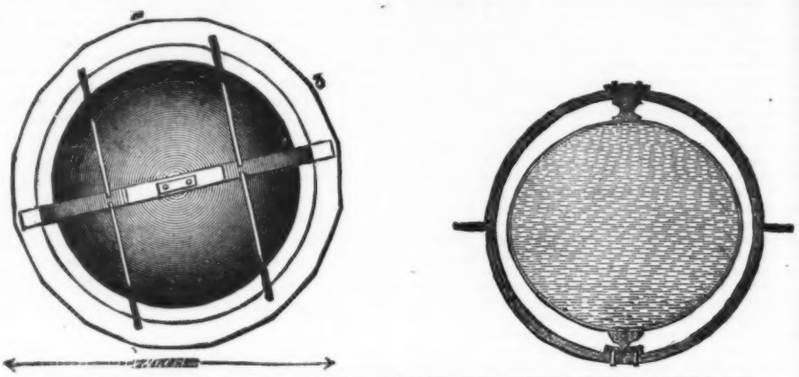
Twelve months ago my instrument, when laid down flat, had a bubble of air in the upper portion of the mercurial limb which had been purposely introduced, and was of obviously less volume than a small pin's head. The instrument has never been reversed to float it out, and the volume of this air is still capable of description as before. This thermometer is four feet or more in length, and the diameter of its index column (which is cylindrical), is the tenth of an inch or so. Its Fahrenheit degrees are represented by spaces of the third part of an inch, and it attains an exceedingly close approximation to the actual temperature of the air in some few seconds time, while an alcohol thermometer moving an equal column through equal spaces for equal numbers of degrees, and with a bulb similar in shape but proportional in size, requires some hours to reach an equally close approximation to the temperature of the air.

The air thermometers I have now described have depended for their indications on the movements of a liquid in a tube. I have, however, devised another in which the movement of the tube about the liquid is the method I employ. In this thermometer (Fig. 3) the barometric tube is circularly curved and mounted concentrically upon a wheel of brass, which is supported in a vertical position by a "knife-edge" of hardened steel which passes through its geometric center and rests on agate planes. Adjustments are provided by means of which the center of gravity of this arrangement can be raised or lowered, and the mercurial column which is seen extending on the right is balanced by a weight which is seen depending on the left. The whole is surmounted by the bulb of air, and the vacant space above the mercury upon the right is the Torricellian vacuum of the barometric column. Changes in temperature are shown by this thermometer in the varying angular positions of a needle prolonged from one or other of the radii of the wheel and counterpoised by a piece of metal on the other side. When the center of gravity of this system has been made coincident with the point on which it turns, the liquid, under changes of temperature, is almost absolutely motionless, while the tube which holds it moves. By bringing the extremity of the needle into contact with a cylinder driven by clockwork at an even speed, we have a thermograph complete. Of course some delicate method of recording must be used, and I have hitherto adopted the smoked paper process so extensively employed in the observatories of France. I prefer to make my records on the albumenized paper prepared for photographic use, and for the sake of the beauty of the black to smoke it over the flame of a common tallow dip. I then fix the records by immersing, cylinder and all, in lac varnish diluted with methylated spirit. In this process there is not the slightest danger of injuring the results; and these, when several times revarnished and mounted upon card and rolled, are doubtless permanent, and are certainly incomparably more beautiful than any other tracings I have seen.

ON AN EXPERIMENTAL ILLUSTRATION OF MINIMUM ENERGY.*

THE experiment was conducted with the actual apparatus which was exhibited to the British Association, at Glasgow, in 1876, altered by the substitution of a shell having its equatorial diameter about nine-tenths of its axial diameter, for the shell with axial diameter nine-tenths of equatorial diameter which was used when the apparatus was shown as a successful gyrostat. The oblate and prolate shells were each of them made from the two hemispheres of sheet copper which plumbers solder together to make their globular floaters. By a little hammering it is easy to alter the hemispheres to the proper shapes to make either the prolate or the oblate figure.

Theory had pointed out that the rotation of a liquid in a rigid shell of oval figure, being a configuration of maximum energy for given vorticity, would be unstable if the containing vessel is left to itself supported on imperfectly elastic supports, although it would be stable if the vessel were held absolutely fixed, or borne by perfectly elastic supports, or left to itself in space unacted on by external force; and it was to illustrate this theory that the oval shell was made and filled with water and placed in the apparatus. The result of



EXPERIMENTAL ILLUSTRATION OF MINIMUM ENERGY.

the first trial was literally startling, although it ought not to have been so, as it was merely a realization of what had been anticipated by theory. The frame-work was held as firmly as possible by one person with his two hands, keeping it as steady as he could. The spinning by means of a fine cord* round a small V pulley of half-inch diameter on the axis of the oval shell, and passing round a large fly-wheel of three feet diameter turned at the rate of about one round per second, was continued for several minutes. This in the case of the oblate shell, as was known from previous experiments, would have given amply sufficient rotation to the contained water to cause the apparatus to act with great firmness like a solid gyrostat. In the first experiment with the oval shell the shell was seen to be rotating with great velocity during the last minute of the spinning; but the moment it was released from the cord, and when, holding the framework in my hands, I commenced carrying it toward the horizontal glass table to test its gyrostatic quality, the framework which I held in my hands gave a violent uncontrollable lurch, and in a few seconds the shell stopped turning. I saw that one of the pivots had become bent over, by yielding of the copper shell in the neighborhood of the stiff pivot-carrying disk, soldered to it, showing that the liquid had exerted a very strong couple against its containing shell, in a plane through the axis, the effort to resist which by my hands had bent the pivot. The shell was refitted with more strongly attached pivots, and the experiment has been repeated several times. In every case a decided uneasiness of the framework is perceived by the person holding it in his hands during the spinning; and as soon as the cord is cut and the person holding it carries it toward the experimental table, the framework begins, as it were, to wriggle round in his hands, and by the time the framework is placed on the table the rotation is nearly all gone. Its utter failure as a gyrostat is precisely what was expected from the theory, and presents a truly wonderful contrast from what is observed with the apparatus and operations in every respect similar, except having an oblate instead of a prolate shell to contain the liquid.

THE MOULD OF BREAD.

WITH a view of interesting our readers who may have microscopes but have not done much in the study of microscopic fungi, we shall give a chapter or two concerning the structure of some cryptogamic plants which one meets with most often. Among these are the moulds which form upon foods, upon the walls of damp buildings, and upon many other objects. One of the most common of these is the mould of bread, which we choose for illustration and description upon this page.

The name of this mould is *Penicillium crustaceum*, and it belongs to the order of fungi called *Hyphomycetes*. The predominant features in the structure of this order, according to Cooke, consists in the development of the vegetative system under the form of simple or branched threads on which the fruit is generated. One of the large genera under this order is one which includes the black moulds which are seen on decaying wood and the like, and another is the *Mucedines*, or moulds on food, etc., to which we would especially refer.

GROWTH OF BREAD MOLD AS SEEN WITH THE MICROSCOPE.

In the engraving, *a* is the bread mould as it appears to the naked eye when full grown. It is trite to say that such a patch of fungus would look like a forest if examined with a microscope, and how far this is true may be learned from Fig. *b*, which shows the mould as seen with a moderate magnifying power. It is plain from this that the mould is really

* By Sir William Thomson, F.R.S. British Association, Swansea, Section A.

* Instead of using a long cord first wound on a bobbin, and finally wound up on the circumference of the large wheel as described in *Nature*, February 1, 1877, p. 297, I have since found it much more convenient to use an endless cord little more than half round the circumference of the large wheel and less than half round the circumference of the V pulley of the gyrostat; and to keep it tight enough to exert whatever tangential force on the V pulley is desired by the person holding the framework in his hand. After continuing the spinning by turning the fly-wheel for as long a time as is judged proper, the endless cord is cut with a pair of scissors and the gyrostat released.

composed of minute plants. The manner of its growth is by the ramification of minute filaments (called the mycelium of the plant), and from these, here and there, there arise thread-like stems which branch at the top and throw out rows of spores like strings of beads. As these spores ripen they fall, as shown at *c*, where the ripened spores are represented as dropping from the plumed top of the stem. This figure is magnified 420 diameters, a power which can only be satisfactorily attained with a compound microscope. The same fruit-bearing stage of the fungus is seen still more enlarged at *d*, merely the apex of the fruit-stem being shown and magnified 620 diameters. A single chain of spores is still more enlarged at *e*, and the spores are seen to be perfectly formed spherical bodies or cells, but slightly attached to each other. As they ripen this slight attachment gives way, and the spores are free. They go hither and thither, and when they fall upon a favoring substance they send forth sprouts, as seen at *f*, and thus new patches of mould are quickly formed, and spread so fast that the substance is quickly enveloped in a coating.

It is often asked, Whence comes the mould which quickly attacks food left exposed in a damp atmosphere? It has been demonstrated that the minute spores are carried everywhere in the air. They are so minute and so light that their transportation is easily effected. As the seed (as it were) of the fungus is thus ever present, it needs but the proper conditions of heat and moisture to develop the perfect plants, when a proper foster substance is exposed. These fungus spores have been gathered from the atmosphere and identified by the microscope.

Moulds may be guarded against by freeing the apartment from moisture. Thus, opening the windows and admitting the sunlight will arrest the formation of mould upon the walls of a damp apartment. A similar result can be attained in cloudy weather by building a hot fire in the room and drying the air thoroughly. In cellars and the like, the fungus can be arrested by a free use of powdered sulphur, or by occasional whitewashing. Such precautions should always be taken, for an atmosphere which favors the formation of mould is not favorable to health and bodily comfort.—*Mining and Scientific Press.*

YANKEES IN RUSSIA.

A CORRESPONDENT of the *Sun*, writing from St. Petersburg, describes at length the position and influence of the several nationalities of foreigners who have made their presence felt in the dominion of the Czar. After speaking of the Germans, the French, and the English, he says: My personal experience is that American citizens in general, and American business men in particular, are warmly welcomed in Russia. On the part of the Czar's Government there is not the least fear that they will inoculate the Russians with republicanism. Once I asked a colonel of gendarmes whether he had any apprehension of dangerous results from the close relations of the Russians and the Americans. "Not the least," he answered, promptly. "Your citizens are too sensible and practical to be dangerous to our government. To imagine a practical Yankee indulging in theorizing with idle Russians would be to suppose the most improbable of all improbable things."

The Russian capitalists and business men in general are apparently glad to have Americans come here, and closely observe their ways of doing business. They prefer to invite American engineers to Russia instead of sending their engineers to study in America. It appears that the work done here by Yankee engineers has confirmed that high opinion which the Russians had formed of them beforehand. The grain elevators built by them in some Russian ports, the boring for petroleum in the Caucasus, and some of their mining experiments, fully satisfied the most extravagant expectations of the Russians. American agricultural machines and implements, sewing machines, iron stoves, rubber goods, canned fruits, and many other articles are in fair demand everywhere in this country, and I have frequently heard here the question, "Why don't the Americans come here to make all these things for us? They would save the expense of transportation, and would be sure to sell their goods." In proof of this last assertion, Russians point to the great and prosperous factory in St. Petersburg operated by the Russian-American Rubber Company.

This suggestion of an investment of American capital in Russian manufacture and trade seemed to me a very interesting one, and I wanted to get opinions about it. A Russian friend introduced me to the Director of the Department of Manufacture and Trade. I asked his excellency whether he would advise American manufacturers to come to Russia and engage in business. "Most heartily," he answered, "though I don't believe that at present your manufacturers can be induced to leave their country of plenty for one that is afflicted with grave troubles. By and by, when the security of business here is insured beyond any doubt, there will be opened an immense field for Yankee enterprise, skill, and capital, and they cannot be beaten here by any foreign competitors for these reasons: They are our friends, and that no other nation can boast of. The general character of America is very analogous to that of our own country. Our Caucasus yields us petroleum, and the Don valley gives us coal and anthracite like Pennsylvania; our middle provinces yield grain as abundantly as the Western States of the Union, and the treasures of our Ural Mountains can be fairly compared with those of California and Colorado. This is a very important point, for the experience of Americans, acquired at great expense, can be fully and profitably applied here in Russia. We have great natural wealth, with no capital and no skill; these the Americans have in superabundance. There can be no political trouble between the two countries to interrupt our business relations. The Yankees are very skillful teachers, as is shown by their perfect absorption and assimilation of an immense and heterogeneous immigration; our history shows that we are diligent and docile pupils. Bring the Yankee teacher and the Russian pupil together, and we will see surprising results!"

Prince O. is one of the largest landowners in Russia. He employs a number of German agriculturists to look after his property—over 60,000 acres on the Volga. I called on him and asked whether he would like to replace his Germans with Americans. "Only let me have some practical American farmers," said the prince, "and I will not employ anybody else. But the trouble is that your farmers seem to be perfectly satisfied at home, and don't care to make rubles and imperials so long as they are pocketing dollars. I think it would pay American manufacturers of agricultural machines and implements to send over here, say, 100 skilled farmers. They would readily find employment with our large landowners, and would be able to demonstrate the full value of the American farm machines. Undoubtedly this would increase the demand for the machines far more surely and rapidly than advertisements, exhibitions, or agents. Russia is pre-eminently a farming country, and her prosperity depends wholly on her crops. Yet we do our farming on a prehistoric plan. Now the crisis has come, and it puts a grave question before us. Either we must immediately apply all the modern improvements in agriculture to our land, or we must be prepared to be cut off from the civilized world. What a chance there is for the enterprising Yankees to come to us, to stir us up, to show us how to handle these wonderful machines, and so to create an immense market for their own wares! Our misfortune is that our educated men become functionaries, parts and parcels of the complicated and rickety machinery called bureaucracy, or else become its bitter enemies, and so the country at large is left without intelligent business men; hence we have to borrow them from abroad. I need not tell you that the Yankees are especially welcome here."

Hating the Germans, looking down on the French, and disliking the English, the correspondent says the Russians seem to reserve all their good-will for Americans. With them "American" or "Yankee" is the synonym of indomitable energy, of intrepid enterprise, of wonderful ability, and of frank truth-telling. They call their own ablest engineers, inventors, and discoverers, "Yankees" by way of compliment. M. Jablochkoff, the inventor of the electric candle, and Colonel Prjevalsky, the bold Asiatic explorer, are sample Russian Yankees.

WHAT INDUSTRY AND THRIFT CAN DO IN THE WEST.—THE MENNONITES.

A CORRESPONDENT of the Chicago *Inter-Ocean*, writing from Topeka, Kansas, gives the following instructive account of what the Russian Mennonites have done in that State. The comparison drawn between their thrifty, home making ways of working and living, and that of many American speculative pioneers, furnishes a lesson well worth heeding by others than pioneer farmers.

In the autumn of 1874 a small colony, consisting of eighteen families of Mennonites, came to the United States from Southern Russia. These were merely the vanguard sent on to choose a location. They were undecided where they should go, and immediately there sprang up a war between the great railroads of the West about which one should locate these people upon its lands. They finally decided upon Kansas as their future home, when the contest narrowed down to the Atchison, Topeka and Santa Fé and the Kansas Division of the Union Pacific. The Mennonites chose the former, and located themselves in Southern Kansas, in Marion, McPherson, Harvey, and Butler counties.

They were poor, having brought with them on an average not more than $500 each. They went to work immediately, bought farms—principally wild land—from the railroad, but, in a few cases, partially improved farms from American settlers who,

FRIGHTENED BY DROUGHT AND GRASSHOPPERS,

were anxious to leave. The Mennonites, however, were not in the least dismayed by either of these. In fact, that Kansas was sometimes subject to grasshopper visitations was to them an argument in its favor, for they are well acquainted with the habits of that insect, and say that it will go to none but a good country.

They were soon followed by large numbers of their friends, and now they number, in the four counties named above, at least 14,000. Their method of farming is so different from that of the American farmer, and in its results has been so much more profitable, that the traveler cannot refrain from instituting a comparison extremely unfavorable to the latter.

In the short space of five years, beginning with but little money, with families to support, two or three years unfavorable, they have, almost without exception, paid for their farms, which range from 80 to 300 acres, built good, comfortable homes, large barns and granaries, put out orchards and groves, bought all the usual farm implements; have horses, cattle, hogs, and, in some instances, sheep, in abundance; have their farms, with the exception of a few acres reserved for pasturage, all in a high state of cultivation, and are free from indebtedness; while the

FARM OF THE AMERICAN HOMESTEADER,

who has been there the same length of time, or perhaps even longer, will not be as well cultivated, the barns and other outbuildings will be small, dilapidated, and almost unfit for use; the house a lonesome, shabby-looking structure; the orchard, if he has any, will be nothing but a few straggling trees, while as for groves and avenues of forest trees, he has never had time to put those out.

In short, there is so great a difference between the two that a stranger can, in a very short time, tell which are Mennonite and which American farms. The *why* of this contains the "root of all the evil" which afflicts Western farm life; and if Western farmers would learn a few lessons from these same Mennonites they would never again be compelled to apply to their Eastern friends for aid.

The Mennonites went upon their farms with the sole intention of making homes of them. They did not expect to ever leave them again. What they wanted was to make a comfortable home, which would yield a competence, and, by reason of their exertions, be constantly increasing in value, while the American farmer, half the time, buys his farm or takes his claim with the intention of making a speculation out of it. He expects to "just put a few improvements on it," and then hold it a few years, until, by reason of advancing civilization, it has increased in value and salability, so that he will be able to make the maximum amount of money out of it with

THE MINIMUM OF LABOR.

Half of the remainder intend to sell if they have a good offer, and so think it isn't of any use to spend so much money on their farms. The remaining fourth are earnestly at work making homes for themselves and their children. But even these are so lacking in habits of economy in both labor and time, as well as expenditure, that they have not half the results of their labor to show that the Mennonites have.

The colonists brought with them much of their clumsy farm machinery, plows, wagons, and many other implements; but when they saw that employed by Americans, their own was soon discarded. In the barnyard of one farm which your correspondent visited lay a Russian thrasher. It was a cylindrical piece of stone about three feet long by one and a half in diameter, having the surface cut into cogs about three or four inches deep, while an axle passed through its center; the wheat was to be spread upon a thrashing floor, horses hitched to the thrasher, and it thus rolled over the wheat. They had a hundred of these clumsy machines made soon after their arrival, but not one was ever used. They soon saw the superiority of the American method and adopted it at once.

But perhaps before proceeding further it would be better to tell something of

THESE PEOPLE AND THEIR RELIGION.

The organization was founded near the close of the sixteenth century by Menno Simonis, and soon spread rapidly through Holland, Germany, and Switzerland. They now number between 200,000 and 300,000, the majority of whom are in America. In doctrine and usages they are in general much like the Baptist church, but are utterly averse to oaths, war, and capital punishment. They are believers in the theory of non-resistance. Indeed, it was to escape liability to military service which led them to emigrate to America.

Their religion discountenances also any participation in civil affairs. As illustrative of this, soon after the first ones arrived they began to try to find some different manner of managing their schools than the American plan, because if they adopted it they would have to become naturalized, vote, and hold office! It was extremely hard for the good Kansas people to understand their hesitancy on the latter subject; but they have become Americanized so rapidly that almost all have been naturalized, and they now vote, and even hold office, in their local affairs; but, in politics, either local or national, they still refuse to take any part, although it is extremely probable that as the younger generation grows up, learns our system of government, and sees what wonderful paths in life are open to every ambitious youth, their religion will be so modified as to permit their active participation in all political affairs.

AN INSTANCE OF WONDERFUL PROGRESS.

A single instance of their wonderful progress will be sufficient, as it is a fair example of what each one has done. Heinrich Richert told us in detail the story of his labors and his success, which, in substance, was as follows: He came in the autumn of 1874, bringing with him in ready money $1,000; he had a family of ten children to support, his farm to buy, buildings had to be erected, farm implements and stock obtained; before he had gotten his farm into good working order he had incurred a debt of $1,300.

Now he is entirely out of debt, has a farm of almost 300 acres, horses, cattle, and hogs in abundance, a good, comfortable house, plenty of outbuildings, and farm machinery of the very best, groves and avenues of forest trees, a thrifty young orchard, plenty of neat, close-trimmed mulberry hedges, while his garden, orchard, and cornfields were as clean and free from weeds or litter of any sort as a smooth-swept floor. In addition to all this, it must be remembered that the next year after he came was the "grasshopper year," and that the last two years have been unusually dry. Here Richert added, as he finished his story, every feature of his good natured, intelligent face, beaming with content and satisfaction, that he looked forward to a long and happy life in his new Western home. He estimated his farm and its belongings as worth, at the very lowest figures, $4,000.

ECONOMY THE SECRET OF SUCCESS.

This is a result which no class of American farmers, North, East, South, or West could or would have achieved. The principal reason of their success lies in their economy. A single instance of this will be sufficient to show that they are the most economical of people. In the majority of cases their fuel is nothing but the refuse of the barn, chopped up with hay or straw, cut into blocks and dried. This with the cuttings of their hedges has served them ever since they have been there, and they expect to use it until the trees, which they have planted, are large enough to use. Contrary to what one would expect, this gives out no disagreeable odor when burning; in fact, the odor is rather agreeable than otherwise, being much like that of peat. Under the same circumstances an American farmer would have done one of three things. He would have hauled wood a long distance, taking a day for each load, and first paying a high price for it; or burned corn; or bought coal, paying a high price for it and consuming much time in hauling it from the railroad. This same economy and thrift is manifest in everything they do. American farmers could learn many lessons from them. Another peculiarity deserves notice. They never build their houses at a distance from one another, but invariably in little clusters of two or three, or perhaps a half dozen or more, thus making a number of little villages at a distance of two, three, or four miles from one another, and adding greatly to the general appearance of the country. When they first arrived one of their elders, looking over the vast expanse of grass-covered prairie, said: "In three years that ocean of grass will be transformed into an ocean of waving fields of grain, just as we left our Molvtschnoi colony." They have certainly kept their promise, and their labors deserve great commendation. Large numbers of them are constantly arriving, and the probabilities are that in a few years this portion of Kansas will be settled entirely by them. They are an intelligent, energetic, industrious class of people, with just those sturdy, upright, and downright characteristics which make the muscle and sinew of a State; and before many years, when they shall have become a little more Americanized, will exert a weighty influence in the affairs of their chosen State. F. F.

GROWTH OF AMERICAN CITIES.

WHILE disappointment has been felt in some cities at the result of the enumeration of the present year, the returns afford striking evidence of the rapid growth of great centers of population in nearly all portions of this Republic. The century was well advanced before a single city in the United States contained more than a hundred thousand inhabitants, as that number was never reported even in Philadelphia and New York before the census of 1820. In 1810, when their relative positions were on the eve of changing, Philadelphia had 96,664 inhabitants, and New York 96,373. In 1820 the population of New York was 123,706, and of Philadelphia 108,116. At the present time twenty American cities contain more than one hundred thousand inhabitants, and there are nearly a hundred cities which contain a larger population than Philadelphia in 1777. She then had 23,734 inhabitants, a number far surpassed by many Western towns and comparatively new Eastern manufacturing centers which were but small villages a few decades ago. Chicago has attained a population of 503,296 during the brief period that has elapsed since Philadelphia and New York combined mustered an equally large population, after a century and a half of continuous growth. Denver, first heard of as a mining camp less than a quarter of a century ago, now contains 35,719 inhabitants, which is several thousand more than were reported in New York by the census of 1790. Kansas

City, which could scarcely have had an organized existence thirty years ago, now reports a population of 56,964. The two leading cities of the new State of Minnesota—Minneapolis and St. Paul—which are in such proximity that their consolidation is only a question of time, contain an aggregate population of 89,942, while ten years ago it was only 33,066. Many other illustrations of remarkably rapid city growth are furnished by the new census returns.

SAVINGS BY POSTAGE STAMPS.

The British Postmaster-General gives notice: In consequence of the expense involved in receiving very small deposits in post office savings banks, no deposit of less than a shilling is accepted. As it has been repeatedly urged that the maintenance of this limit placed very serious obstacles in the way of saving by those who could only put aside a few pence at a time, it was stated at the close of last session that a plan was about to be tried experimentally in certain counties which would enable small savings to be effected by the use of ordinary postage stamps. The plan was brought into operation on the 13th September, in ten counties situated in different parts of the United Kingdom, and during the seven weeks it has been in operation the success obtained has been so marked that it has now been decided to extend it to the entire country. This decision will take effect on Monday the 15th November. On and after that day, at every post office in the United Kingdom, forms for the making of small deposits in post office savings banks will be issued gratuitously. Each of these forms, which are about the size of an ordinary check, will have twelve divisions, in each of which a penny postage stamp can be placed. When a form has thus been filled with twelve stamps it will be received at any post office at which there is a savings bank as a deposit of a shilling. During the seven weeks that the experiment has been in operation more than 14,000 of these forms have been received, and more than 7,000 new accounts have been opened through their agency. As the selected counties contain less than one-tenth of the entire population of the country it may be fairly assumed that if the plan had been applied in the first instance to the whole country, it would, during the period referred to, have led to the opening of more than 70,000 new accounts. The following are the ten counties in which the experiment has been tried, and they are arranged in the order in which it has been most successful in proportion to the population of the respective counties: Cardiganshire, Ayrshire, Kent, Aberdeenshire, Cumberland, Somersetshire, Norfolk, Leicestershire, Down, and Waterford. The forms, after being received at the local post offices, are transmitted to the general post office; they have come to hand in remarkable good order, most of them presenting the appearance of perfect newness, and it has not been necessary in a single instance to return any of the forms on account of their being damaged or defaced.

THE BIRTHPLACE OF MONTEZUMA.

By THEO. S. CASE, Kansas City, Mo.

ARRIVED at Baughl's Station, on the Atchison, Topeka and Santa Fé Railroad, which is no more than a siding where railroad ties are received and handled, and which simply consists of a boarding car and two saloons, we started on foot for the scene of our explorations, about one mile and a half distant. Before entering upon a description of the ruins found here, I will say that notwithstanding the volumes that have been written by the explorers of this central portion of the Western Hemisphere, descriptive of its past civilization, the vastness and perfection of that civilization have been by no means comprehended. Every day the hardy and venturesome prospectors of New Mexico, who, like the Spaniards of the sixteenth century, are urged on by an ardent quest of precious metals, discover new evidences of the existence in prehistoric times of a race of men who, in architecture, agriculture, and metallurgy, possessed a degree of knowledge and skill hardly surpassed in any age.

The discoveries of these explorers also go far to prove that the land which is now so utterly unproductive, was once sufficiently arable and prolific of vegetation to support a dense population, and that the various reasons which are proposed by the writers of the present day to account for the abandonment of the country by these people, such as superstitious fears, the aggressions of hostile tribes, etc., are futile and unsatisfactory.

It seems unquestionable that some vast change took place in the geological and physical condition of the country, causing its fountains to dry up, and changing its fertile valleys into arid wastes, thus literally starving the people out and forcing them to seek new homes. This idea brings to the front the theory and tradition of the Continent of Atlantis with more plausibility than almost any other; a theory which, if established, will enable us to account for the migration of ancient peoples from one continent to the other without tasking our credulity with the extremely doubtful one of the Behring Straits route.

Before we had proceeded more than half a mile we came into view of the church and ruins of Pecos, lying on a beautiful plateau on the further side of the Pecos River, and separated by a narrow valley from a commanding range of mountains several miles beyond. This plateau seemed to be completely surrounded by mountains; those on the west being grand in their outline and crowned by a bald peak, which appeared exactly adapted for a watch tower for the people of the city on the plateau, and perhaps for an outlook for the priests of the sun, who from its lofty summit, could catch his earliest rays long before they would be visible to the people below. The whole valley, from mountain range to mountain range, is about five or six miles, while it seems to be inclosed at both ends by purple ranges, about ten miles apart, with an occasional snow-capped peak. Thus apparently hemmed in on all sides, and in the midst of what was probably in the day of their prosperity a luxuriant and fertile plain, these ancient people built their singular houses and lived peaceful and quiet lives. The evidences of their civilization are found in abundance, in implements for grinding corn, pottery, evincing various degrees of skill, and in some places in pictured rocks and decorated caves.

These houses are very much alike in all the villages that are known, being built against the sides of bluffs or rocky acclivities, one story above another to the height sometimes of five to six or seven stories. The material used is stone, cemented together, and sometimes coated or plastered on the outside with mud. The first story has no opening except at the top, which is reached with a ladder, while the other stories have doors opening from the roofs of those below. Within, or at least in the lower or basement stories, there are connecting openings from one to another. The stories are separated by floors of timbers laid together and sometimes bound together with withes. Remains of corner posts made of pine and cedar poles are found abundantly in their proper position.

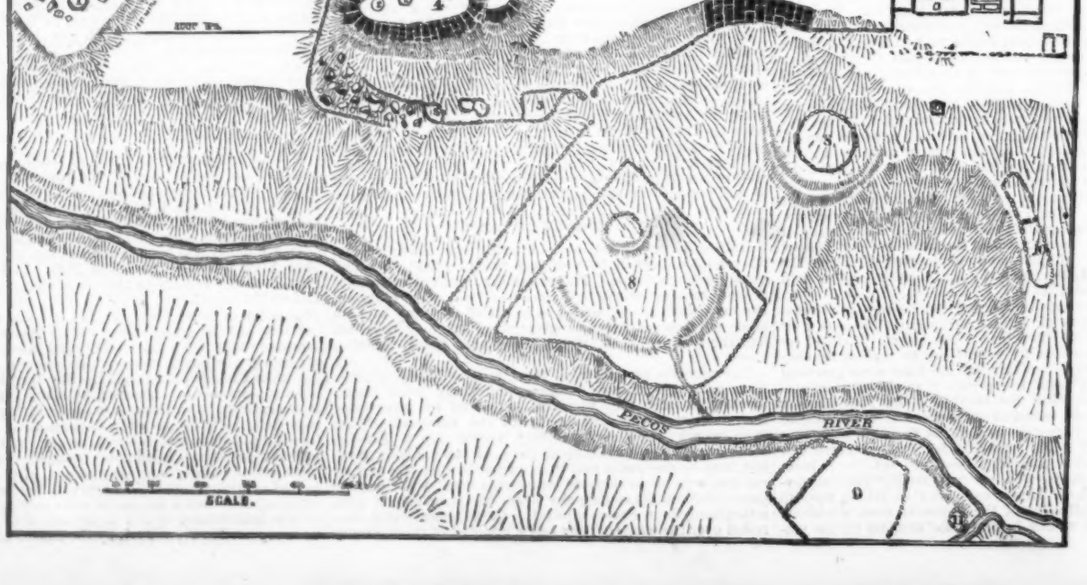
The system of walls and outworks is very extensive, but whether it is all of the same age as the village, is more than I was able to determine. Commencing at the western end of the plateau, the first evidence of the hand of man that I discovered was a circular stone wall inclosing a space thirty feet in diameter. This is located upon a rocky point some fifty feet above the adjacent ground, and commands a view of the valleys on both sides, as well as of the plateau beyond upon which the village is built. From all indications this was a fort or lookout tower. (W. H. Holmes, in Bulletin No. 1 of the United States Geological and Geographical Survey of the Territories, vol. ii., 1876, describes the ruins of a tower found in the Mancos cañon in Colorado, probably similar to this, whose outer dimensions were forty-five feet in diameter, and twelve feet in height at the highest point of the wall yet standing, which is twenty-one inches in thickness. It was double walled, with apartments between the outer and inner walls.

PUEBLO VILLAGE AT TAOS, NEW MEXICO; NOW INHABITED.

On the *mesa*, above the bed of the River McElmo, a square shaped tower was discovered standing in on the summit of a great block of sandstone, forty feet high and detached from the bluff back of it.

At another place on the McElmo, the ruins of a triple walled tower were found, with sectional apartments between the outer and second walls, and such towers abound on prominent points all along the Gila, Chaco, Rio Grande, and other rivers of Colorado and New Mexico.

Proceeding eastwardly, we descend from this point some twenty feet or more to a long and narrow passage of bare rock, not less than 1,000 feet long, by an average width of about one hundred feet. On the north side, this passage is defended by a stone wall running along the edge of the rock for a distance of about 300 feet. For the remainder of the



distance to the foot of the bluff upon which the ruined village is built, there is no sign of any work done by man.

At the foot of the bluff just mentioned, we come upon the remains of a stone wall which runs around both sides of the plateau from village to church, being in its whole length not less than 2,000 feet. This wall seems to have been intended for defense, as it is located on the extreme edge of the plateau, all around, just where the steep and almost perpendicular declivity begins.

Commencing here, we are amazed at the size of these ruins. (4.) The buildings were commenced at the foot of the bluff, the rooms of the first story being, say, 8x10 feet and about 7 feet in height. The rooms on this floor have no doors in the side walls, but are entered from the roof, which is reached by a ladder. Upon this story another is built which sets back from the front of the first, and like it leans against the side of the bluff. This story has doors in the front of the rooms, which are entered from the roof of the lower story. In this way as many as six or seven stories are built one upon another, and the buildings are extended laterally as far as the necessities of the community demand, all united as closely together as cells in a honey-comb.

In this Pecos village there were not less than 1,000 rooms, and probably many more. I could readily count two hundred rooms at the top, and from four to six stories on the sides of the bluff. The whole group seemed to consist of two irregular circles, the larger of which extended partially around the end of a rocky bluff about thirty feet high above the bare rock just described, rising two stories above its summit and completing the circle or oval upon the surface of the bluff. This circle is two hundred and twenty-five feet across in one direction, say east and west, and seventy in the other, with one opening or passage, say sixteen feet wide, leading down the face of the bluff on the northern side, and one into the inclosure on the east.

This area contains two basin-shaped, stone-lined reservoirs, probably for water, twenty-five feet in diameter and more than six feet deep (2), as was proven by digging into them to that depth without finding the bottom of the stone lining. They are filled with earth to within some three or four feet of the surface. Outside of the circle of huts, at the foot of the bluff on the north side, but inside of the stone wall above named, are two similar stone-lined, basin-shaped reservoirs, sixteen feet in diameter and filled within two or three feet of the surface. (3.) One of these is on each side of the passage way before mentioned. A very singular thing is, that the western of these reservoirs seems to be connected with one of those inside, by an aqueduct or conductor, constructed wholly of cement made of ashes and some other substance, possibly lime, though no lime or cement of any kind is found in any other part of the works.

This aqueduct is exposed at the margin of the reservoir nearest the bluff and is at least two feet in diameter, with walls not less than eighteen or twenty inches in thickness. It was constructed by making lumps and blocks of the cement, some rounded and some flat, varying from four to ten inches in diameter and laying them upon each other like bricks, and fastening them together with layers of similar cement, and finally smoothing the whole over with a coating of the same. I had no implement but an old hatchet, and could do but little in the way of excavating this aqueduct, and may have been mistaken as to its object and purpose, but from its locality and shape, as disclosed by my cutting into it some two feet or more, I think I am correct.

Adjoining the inclosure above described on the east, is a small one, also built around with similar stone huts, two stories high, which is about sixty by seventy feet in diameter and has two gateways, one to the northeast and the other to the southeast, each ten feet wide and thirty-six feet long. To the southward of both of these inclosures and close to the rocky declivity, which is bold and commanding, are several remains of walls and buildings, nothing being left but the foundations and some loose rock. The first or western of these is 24x58 feet, the second 24x27, and the third 10x30. Still further east, and on the extreme point of the rock, is a triangular-shaped inclosure 54x69, the third side being made by the wall on the edge of the bluff. From the situation of these (5), especially the last named, they were evidently for the purposes of defense and outlook.

Just east of the huts last described the ground slopes rapidly to the east and south, with ledges of bare rock making a kind of wall to the southward and westward. Still proceeding eastwardly we pass over some two hundred feet of bare, smooth rock, when we come to two other groups of ruins (6), about four hundred feet in length, one on each side, and overhanging the respective bluffs on the north and south sides of the plateau. There are about eighty huts in each of these groups on the summit, making probably about two hundred in all, when averaged at two stories high. They are similar to those just described, being made of stone cemented together with mud, and arranged in rooms of from six to ten feet square, those in the basement story being connected by openings underground. Between these groups of huts the space is nearly or quite two hundred feet wide.

We did not find any rooms among them answering to the description given by several explorers of the *Estufas*, where the sacred fire was kept burning, unless the circular, stone-lined basins, within the court of the larger village, may have been originally covered over and used for such a purpose.

Dr. Hammond, who accompanied Lieutenant Simpson in his United States military reconnoissance in New Mexico, in describing the ruins of Chaco, speaks of sacred *Estufas*, circular in form, excavated several feet deep in the earth, and inclosed with circular walls. The fact that no water, except perhaps the drippings from the roofs of the upper tier of huts, could naturally find its way into these basins, gives probability to the suggestion that they may have been constructed for *Estufas*, instead of for storing water.

On the south side of the plateau, about half way between the first and second village, is a gateway in the outer wall, which in that part is six or seven feet high, and from three to four feet thick. This gateway is about ten feet wide, and was apparently made to enable the inhabitants to pass out their stock to graze and to water in the inclosures which will be described a little later.

Having now described nearly everything on the plateau that seems to belong to the Aztec civilization, we will pass out of the gate just mentioned, on to the slope that descends gradually to the Pecos River, which winds its way along at a distance of a few hundred yards to the southward.

The first thing which attracts our attention is a long stretch of ruined wall which extends in a southwestwardly direction from a point within about 120 feet from the gate to the bank of the river, 600 feet away. Just beyond the upper end of this wall we find an inclosure (8), walled all the way around, 300 feet by about 120 feet, and banked up with earth at the lower part as if to retain water. Just at the lower corner there appears to have been an artificial outlet through the dam and wall for prudential purposes. Within this inclosure is a circular artificial pond, also banked up with earth, about seventy-five feet in diameter. Just east of this inclosure and a little further up the slope is another (8), apparently constructed for the same purpose, being nearly as large and banked up across the lower part in a similar manner. Within this, also, is a smaller circular pond 120 feet across, which even at this time was muddy in the center, although it did not contain any water.

Still proceeding eastwardly, there are traces of walls and apparent foundations of buildings all along the slope, and on a little eminence about 200 yards southeastward of the inclosure last described are the remains of two walls (10), inclosing spaces respectively 100 feet square and 125x140.

On the opposite side of the Pecos River, between it and a small stream which empties into it, and 345 feet southeast of the water inclosure first above described, is a kind of pentagonal inclosure 240 feet in diameter (9), and crossed by another wall which divides it into one large and one very narrow compartment. Just beyond and southeast of this are the remains of what has apparently been a fortification, situated just at the confluence of the two streams.

This completes the description of the outside works. We will now return to the plateau. Passing from the groups of Aztec huts last described, we proceed eastwardly 180 feet and find ourselves face to face with the old Pecos church itself. Before describing this old building (7), we will refer to the history of the discovery of the village, which had its origin long before the Spanish invasion, and which is held by the Aztecs to have been the birthplace of Montezuma himself.

There seems to be no doubt that the Aztecs migrated from some more northern region, into Mexico, and the traditions of the present Pueblos, who are believed to be descendants of the original Aztecs, teach that this very spot was the birthplace of Montezuma. But Short, in his "North Americans of Antiquity," claims that this is a different civilization, and that the culture-god Montezuma of the Pueblos and the Aztec monarch, Montezuma, are not to be confounded. Dr. Foster, in his "Prehistoric Races of America," does not speak of any such distinction. At all events, all writers agree that Pecos is one of the most important of all the ancient ruins of this region, and that it was one of the sacred cities of the Pueblos. Here the everlasting fire, dedicated to their god Montezuma, was kept burning from time immemorial down to the abandonment of the town, which occurred, according to Short, some time during the second quarter of the present century. Other authorities fix the year at 1837.

One tradition is that Montezuma was born at Acoma, and subsequently removed to Pecos, where he taught the people the arts of civilization, and that when he removed to the South he told them to keep the sacred fire burning until his return. But he never came. Warriors watched the fires and remained on duty by turns, until through decimation from one cause and another, the tribe became too much reduced in numbers to keep up the watch any longer. Then three warriors took the remains of the fire and carried it into the mountains, where Montezuma himself appeared and received it. Thus relieved, they abandoned their village and joined their brothers west of the Rio Grande.

"For generations," as Short eloquently says, "these strange architects and faithful priests waited for the return of their god—looked for him to come with the sun, and descend by the column of smoke which rose from the sacred fire. As of old the Israelitish watcher upon Mt. Seir replied to the inquiry, 'What of the night?' — 'The morning cometh,' so the Pueblo sentinel mounts the housetop at Pecos, and gazes wistfully into the East, for the golden appearance, for the rapturous vision of his redeemer, for Montezuma's return, and though no ray of light meets his watching eye, his never-failing faith, with cruel deception, replies, 'The morning cometh.'"

In about 1540 Coronado, the Spanish governor of New Spain, lured by the resistless rumor of boundless wealth of gold and silver, which no Spaniard could withstand, led an expedition to this very village, then called Cicuyé. The Pecos River must have been a far larger stream than at present, as Coronado found it frozen over with ice strong enough to bear up his horses. He found the settlement of Cicuyé extending along the river for six miles, and the soil extensively cultivated by the Indians. It was from that time that the decline of the tribe commenced. The date of the building of the church is not exactly known, but it was probably very soon after the invasion by Coronado, for zeal in religious matters was next to lust of gold in the heart of the Castilian in all of his conquests.

We may imagine that the gentle and tractable Pueblos were speedily induced by their enthusiastic conquerers to embrace Christianity, and that the building of this church was a work of fear of temporal power, rather than of faith in and love of the deity represented by the Spaniards. It was constructed of adobes, which are about sixteen inches long, twelve inches wide, and three inches thick. Its shape is that of the Latin cross, its walls six feet thick, and its dimensions one hundred and forty feet long by forty feet wide; the transverse portion being fifty seven by thirty-five feet, and its original height about thirty feet. There were several smaller rooms attached on each side, and possibly a building of considerable dimensions on the west side, as there are traces of adobe walls which indicate either a building or an inclosure divided into several smaller rooms or lots. I have in my possession a book published in 1854, containing an engraving which represents the church as having a building on the west side. I could find nothing in the appearance of the ground to indicate anything of the kind, either in the way of rubbish or otherwise, and it seems to me, if the church itself could so well withstand the ravages of time, any adjoining buildings would have endured as well. The roof of the church has been nearly gone for many years, and the side walls of the front end are also crumbled away nearly to the ground. The rear portion is nearly at its original height, and some of the cross beams, with their rude carvings, remain *in situ*. The others have been cut away by curiosity hunters.

The adobes of which the building is constructed are made of a reddish clay containing small pieces of pottery of a ruder and coarser order than that found about the Pueblo villages. In one of these inclosures just west of the church is a small excavation about twelve feet in diameter, evidently the remains of a water reservoir. Immediately in front of the entrance, and about forty feet from it, is what seems to be an old well, which had been walled up with stone and has been more recently filled up with earth.

About seventy-five feet still further on, we come to the traces of an old wall terminating on the east in the ruins of several small rooms or inclosures, also of stone. About eighty feet still further, and directly in front of the entrance to the church, is an inclosure about eighteen feet square, with a central stone heap about three feet square. Still further in the same direction we find a semicircular declivity, which was probably originally the work of man, which terminates on the right at the water inclosures described above, and on the left at the stone inclosures already described.

In speaking of walls, it is to be remembered that most of them are ruins, and many of them mere traces, although readily discernible as one walks over the ground.

Leaving the church for the present, we will turn back to the ruined villages in search of relics. Broken pottery abounds on all hands, and it seemed to me that I could detect specimens representing at least three distinct periods of time: First and oldest, that found in the adobes of which the church is built, which is coarse and rough; second, that which is made of finer clay, but without ornament, and lastly, that which is painted; and perhaps, fourthly, that which shows an effort at glazing.

We found numerous flint arrow heads, all of which were small, none being over one and a half inches in length. Perhaps this is due to the fact that the larger ones have been picked up by earlier explorers. We also found several broken *metates*, or grinding pestles, and in one of the large rocks near the upper village, I found three bowl-shaped cavities, about ten inches in diameter and from three to four inches deep, which I conceived to be the mortars in which the natives ground or beat their corn into meal.

We also found numerous pieces of obsidian which appeared to have been split off in keen flakes for cutting purposes; also fragments of smoking pipes with more or less ornamentation cut or scratched upon them. Besides these things, we discovered smaller ornaments, in the way of shells pierced for suspension, pieces of selenite roughly carved into ornamental shapes, and small bits of red paint. Not a scrap of iron or any kind of metallic weapon, tool, or implement could be discovered in either church or village—not even a nail—though it is well known that the natives understood the art of smelting ores, at least those of silver and gold, and of working them most artistically. If other proof of this knowledge were wanting, we could supply it in the form of several pieces of slag picked up near the villages; and the people who reside near say that remains of old smelting works are still to be found in the mountains.

Parts of three days were given to this exploration, in company with Mrs. Case, Major H. Inman of Kansas, and Mr. A. H. Whitmore of Las Vegas, all of us being greatly interested and more than willing to devote much longer time and labor to a more complete examination of these ruins, should another opportunity present itself when we were better prepared to do them justice.

A great many more most interesting things were seen by us in New Mexico, but the limits of this paper have been reached, and an account of the remainder must be postponed until another time, with the closing suggestion, that had these industrious and ingenious natives not been disturbed and driven out by the thriftless and avaricious Spaniards, who have never improved any country by their conquest of it, they would in all probability have built up the ruling empire of North America, and thus at least have kept alive the fire of civilization kindled by Montezuma—the culture god—in their minds, until the day of his return, in the millennium.—*Kansas City Review.*

SMYRNA.

AT this moment, when the Eastern Question is an all-absorbing one in England, it may be of some interest to the numerous readers of the *Journal of the Society of Arts* to know the facility with which land is acquired in this country, and the remuneration for the capital laid out on it.

The province of Smyrna, otherwise Vilayet of Aidin, is eminently a maritime province; its length of sea coast is computed to be 250 miles, its depth inland averages about 100 miles, consequently the whole area is about 25,000 square miles, or nearly as large as Ireland.

The population of the province is computed to be 1,000,000. This will give us a density of forty inhabitants to the square mile, which is the lowest number, as compared with any other maritime province of Turkey. About ninety per cent. of the rural population are Turks; they are sober, peaceful, and to some extent industrious.

As to the quality and fertility of the land, it is enough to cite the beautiful and celebrated valleys of the Meander, Hermus, and the Cayster, which are the three jewels of the province, crowned on each side by lofty chains of mountains, full of mineral wealth. Its climate, generally very healthy, is mild in the valleys, and pleasingly cool in the mountains. Tmolus is capped with snow all the year round. The plains, in addition to all the different species of corn, produce the valuable staples of cotton, madder roots (*Rubia tinctorum*), the poppy, hemp, sesamy, tobacco, licorice (growing wild), etc. In fruits, we have both the European and Eastern varieties, but the staples consist of figs, the finest in the world; the various qualities of raisins, from the delicious Sultanine to the common black raisin, so extensively exported of late into France, both for the manufacture of wine and the distillation of spirits; and last, but not least, the olive. In the highlands, in addition to corn and fruits, the staple produce is the vallonea (*Quercus ægilops*), of which not less than 1,000,000 quintals or hundredweights is exported annually from this place. Madder is driven out by the aniline dye process, described in the *Journal*.

Although the working of mines is yet in its infancy, still 30,000 quintals of emery stone is exported annually. Coal and lignite exist in many places, but are little worked, any more than the hematite iron ore and copper.

The value of landed property in and around cities is, as compared with the value of rural property, proportionately far higher than in any other country; this arises from various causes, first, from want of security; second, from the unlawful exactions on the part of tithe officials, to which the people are often subjected, when removed some distance from the centers of authority; and third, from the lack of any other safe investment of the savings of the urban population; hence property in Smyrna will fetch about three per cent. per annum, while in the rural districts not less than ten per cent. The land is measured here by doonooms (about one-fourth of an acre). The salable value of land here, like anywhere else, depends on its quality, the hygienic state of the district, its vicinity to cities, and, above all, the density of population in its neighborhood. The average price of arable land in well-populated districts is 30s. a doonoom, and in thinly-populated parts it might be obtained for less than 5s. Vineyards from £2 10s., fig gardens from £4 to £20 a doonoom, olive groves are generally sold by the tree, from 5s. to £2 a tree. Of course these prices are conventional.

Rural property in Turkey generally belongs to the crown (*arazi miriè*), which is supposed to be the proprietor. Its

sales are performed with the following provisos: At every transfer a tax of five per cent. on the purchase money is levied by the government, and its inheritance is limited to eight degrees of consanguinity: first, children of both sexes; second, grandchildren of both sexes; third, to father and mother; fourth, to brother and half-brother, by the same father; fifth, to sisters and half-sisters, by the same father; sixth, to brothers, by the same mother; seventh, to sisters, by the same mother; eighth, to the surviving husband and surviving wife. If no heirs, comprised in the above eight degrees of relationship, exist, the land returns to the crown. After the acquisition of any such crown lands, if the owner plants upon it a vineyard, vegetable garden, orchard, olive grove, or constructions of any kind built upon it, all such superficial property becomes freehold, and is, in consequence, inheritable by any distant relations. I am not going to enter in detail upon the intricacies of *vakufs*, church property, of which there is but little in the rural districts. These are only inherited by the direct descendants of both sexes of the owner; there is also a fixed yearly perpetual money rent to be paid to the church.

The legal direct taxes upon the rural lands, of whichever category, are twofold—first, one-tenth of all produce grown, whether on the ground or trees; second, four per mille is levied annually on the estimated value of the land and farm buildings. Urban house property is taxed eight per mille on its estimated value per annum.

Mode of Cultivating the Land.—In a country so sparsely populated as this is, and where fertilizing substances are only used for gardens, cotton and tobacco fields, it is not to be wondered at that every third year the land remains fallow. Thus, a field which is sown with a summer crop, such as Indian corn, millet, sesamy, beans, vetch, etc., is in the following autumn sown in with wheat, barley, or horse beans, etc., which are the winter crops; the third year the field is left fallow.

The agricultural implements in actual use, if not dating from the time of Homer, are certainly of the most primitive style. The following are the principal implements in use: The plow (simply a triangular block of hard wood, with an iron cap on the point, one pole in front to yoke the oxen to it, and one behind to guide it), the harrow, rake, sickle, spade, pickaxe, shovel, pitchfork, sieve, winnow, and a coarse two-wheeled bullock cart. The plowing is done about three or four inches deep, while the distance between each furrow is twelve inches wide. With such a method of tillage, it is only a marvel that a tenfold produce of barley and wheat, 20 to 25 of beans, 25 to 35 of millet and maize, is considered to be a good out-turn. Although there is hardly a drop of rain from May to October, still irrigation is not made use of for any other purposes than vegetable gardens, and occasionally for the maize fields.

The thrashing of cereals is performed by horses and bullocks, and that of beans, sesamy, millet, etc., by the flail or simple stick. After the thrashing is over the straw is chopped up by a kind of harrow, fitted with sharp-edged disks, and stored away as fodder for the cattle.

The rural lands are divided into large farms (chiftlik), owned by the wealthy classes and in small peasant proprietorships. The large estates are generally worked, as in the southern countries of Europe, by the peasantry on the half-profit system, the proprietor giving the land, seed, and half the expense of reaping if cereals, of harrowing and weeding if cotton, maize, or beans, etc. After deducting the fiscal share of ten per cent., and divers other common compensations paid in kind, such as village herdsmen, rural police, etc., the remainder of the produce is divided in two equal shares—the one for the proprietor and the other for the peasant. In some parts of the country where the population is sparse a system of leasing the land for one year exists, but the peasants prefer the half-profit system, for the reason that they require no capital; moreover, whether the season be good or bad, they always manage to get their breadstuff stored away till the next harvest by contriving to steal some of the seed, or when the harvest is gathered in, also their wives and children have a legitimate resource in the shape of gleaning. Certainly not less than eight per cent. of the cereal produce is left on the ground by the reapers.

Having, as I already pointed out, the advantage of such an extended sea coast, as well as the two lines of railway—Smyrna to Aïdin and Smyrna to Alasheir—leading a fair distance in the interior, all this facilitates the transport of the produce for exportation; therefore, both peasant and proprietor are, comparatively speaking, in easy circumstances. True, the requirements of the rural population, as far as food is concerned, are not much; bread, vegetables prepared with oil, milk, pekmez (a sirup extracted from the black raisin), form their staple food. Meat and rice are only occasional luxuries with them. On the other hand, our rural population spend a good deal in dress. Unlike the peasants of European Turkey, whose clothings are made of native manufacture, here their cloth and linen are of foreign make, and, consequently, more expensive.

As a rule, the peasantry in this country do not plant any vegetables, therefore gardening forms a separate and very remunerative industry both in the cities and the rural districts. This may be inferred from the following instance: I know a gardener's family in this city, consisting of a man, wife, and child, who has a tenement of two acres of garden and orchard; he pays £10 rent, £2 10s. taxes annually, keeps two permanent servants, and occasionally employs additional hands; he also keeps two horses; and all manage to live decently upon the produce of that garden. Lastly, the peasantry have another resource of income in the breeding of cattle; the fodder, as aforesaid, consists of straw, and the pasturage costs them nothing; the only tax they have to pay on this head is for sheep, goats, and pigs—for the former two, 9d. each a year, and for the latter, 1s. 10d.

In conclusion, the state of agriculture in Asia Minor generally must not be confounded with that of this propitiously situated province; otherwise so abundantly gifted by nature, the lot of the peasant, the farther removed in the interior, the more unfortunate it is, both on account of the want of roads and the desert in which his repining voice is lost.

S. STAB.

Smyrna, September 4, 1880.

THE Mosaic Sabbath, said Prof. Tyndall in a late address to a branch of the British Sunday Society, was designed to be a day of cheerful renovation, both of body and spirit, and not a day of penal gloom. This is true, and the day among a large proportion of the strong and earnest Christians who have moulded the best social and political institutions of our time has been rather gloomy, to be sure. But Sabbath means rest. What man most needs is rest. How to secure that rest which will restore the vitality of body and mind after a week of toil is one of the great unsolved problems of sociology.

PROGRESSIVE MOVEMENT OF STORMS.

PROFESSOR ELIAS LOOMIS, of Yale College, in a paper on the "Causes which Determine the Progressive Movement of Storms," says:

For the purpose of discovering the causes which determine the progressive movement of storms, I have made an extensive examination of the course and velocity of storm centers in tropical regions, and also of abnormal paths in the middle latitudes of Europe and America. I have examined the courses of all those hurricanes which have originated near the West India Islands, and also all the storm tracks delineated on the maps of the *Monthly Weather Review*. I have examined the courses of all those hurricanes in Southern Asia and its vicinity, the paths of which have been best determined, and also all the storm tracks delineated on the maps of the international series of observation. The following summary presents some of the results derived from this investigation:

1. The lowest latitude in which a cyclone center has been found near the West India Islands is ten degrees; and the lowest latitude in the neighborhood of Southern Asia is six degrees. Violent squalls and fresh gales of wind have, however, been encountered directly under the equator.

2. The ordinary course of tropical hurricanes is toward the west-northwest. In a few cases they seem to have advanced toward a point a little south of west, and, in a few cases, their course has been almost exactly toward the north.

3. Tropical hurricanes are invariably accompanied by a violent fall of rain. This rainfall is never less than five inches in twenty-four hours for a portion of the track, and frequently it exceeds ten inches in twenty-four hours.

4. Tropical storms are generally preceded by a northerly wind, and after the passage of the low center, the wind generally veers to the southeast at stations near the center, and the southerly wind which follows the low center is generally stronger than the northerly wind which preceded it. This fact appears to suggest the explanation of the origin of the cyclone, and the direction of its progressive movement. The prevalent direction of the wind in the neighborhood of the West India Islands is from the northeast. Occasionally a strong wind sets in from a southerly quarter. The interference of these winds gives rise to a gyration, and a fall of rain sometimes results. When rain begins, the latent heat which is liberated causes an inflow of wind from all quarters, by which the rainfall is increased; and since the winds are deflected by the rotation of the earth, an area of low pressure is produced, and the force of the winds will be maintained as long as the rainfall continues. The effect of this strong wind from the south is to transport the low center in a northerly direction; and by the combined action of this south wind and the normal wind from the northeast the center of low pressure is usually carried in a direction between the north and west.

RELATION BETWEEN TERRESTRIAL TEMPESTS AND THE ROTATION PERIODS OF OUR SOLAR SYSTEM.

UNDER the above title Prof. Zenger read a memorial before the Royal Society of Sciences, at Prague, in Bohemia, and the last number of the *Rivista Scientifico-Industriale* brings some interesting remarks on the same subject by Dr. Ciro Ferrari.

The sun, as is well known, needs for a half rotation 12,586 days. The years of rotation of the planets are simple multiples of this number, for example:

Jupiter's rotation is completed in			344×12,586.	
Mars'	"	"	344	"
Vesta's	"	"	104	"
Ceres'	"	"	} 133	"
Pallas'	"	"		
Saturn's	"	"	845	"

With this period of 12·6 days are also connected the tempests, inundations, great falls of meteors, and perihelia of the comets.

The new investigations of Prof. Zenger, in which he speaks of a memorial of Prof. Suess, entitled "Sui Terremoti dell' Italia meridionale dal 1349 al 1873," show that the earthquakes, also, are dependent upon the same period,* and that:

1. The greatest deviation from the middle of this period is one-fifth of the whole duration of rotation, or five days.

3. The mean of the deviations is only about one-seventh of a day.

3. Earthquakes always occur very near to the day of the period, sometimes a little earlier, sometimes a little later.

"The sun, therefore," says the author, "not only influences the periodicity of the planets and the orbits of the meteorites, but also plays the chief part in regard to the disturbances of our earth."

Recently some pamphlets have been published in Italy regarding Seismology, which greatly increase our knowledge of that subject. We mention "Meteorologia Endogena," by De Rossi; "Storia Sismica di Verona," by Prof. Goiran, etc., and above all, "Il Vulcanismo Italiano."

The author says: The coincidence of the period of the perihelia of the comets with that of the meteorites is a new argument in favor of the theory of Prof. Schiapparelli, that the meteorites are nothing else than a dissolved comet. This is also confirmed by the fact that the comet Biela did not appear the last time as it should have, but at the time of its presupposed reappearance, there was in its place an extraordinary fall of meteors. The author gives a table of the perihelia of the comets from 1867 to 1879, and Prof. Zenger in his latest pamphlet has also added two tables, indicating atmospheric and cosmic perturbations, and a comparison between the mean data of the atmospheric perturbances and the earthquakes. From a catalogue, compiled by H. Rubenson, which contains the auroræ boreales that appeared from 1536 to 1799, Prof. Zenger has gathered some notes which show interesting coincidences between this natural phenomenon and his own theory:

1583, August 17, 18, 19.
" October 8, 9, 10, 11, 20, 21, 25.
" November 7, 8, 10, 11, 23.
1584, January 3, 4, 5, 6, 16, 17, 18.
1790, August 17.
" September 6, 7, 8, 9, 13, 16, 29, 30.
" October 1, 2, 3, 4, 9, 12, 17, 18, 27, 31.
" November 7, 9, 11, 13, 16, 27, 28, 29.
" December 9, 10, 13, 25, 26.

From this may be seen that they occurred in the days of the great meteoric falls.

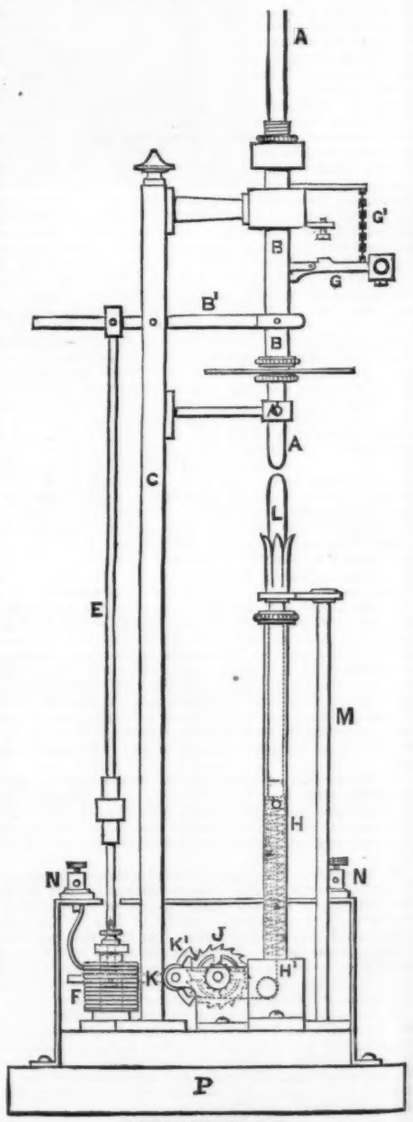
Dr. Zenger says that, to the idea of Schiapparelli, regarding the meteorites, may be added, that comets and meteorites, when they approach the earth, not only act upon the latter mechanically by means of their attraction, but that they also produce dynamo-electric phenomena which will be seen in the auroræ boreales. So also the sun not only influences its system by the force of gravitation, but it also influences the atmosphere and the solid bodies of the planets of its system by causing their rotations and producing dynamo-electric phenomena. In other words, the sun is in organic relation with the bodies which depend upon it, be they planets, comets, or meteorites—different states of matter—and that its influences are regulated by periods which are multiples of the above-mentioned number, 12·6, indicating the time of a half rotation of the sun.

Regarding the auroræ boreales, the author observes that the restitution of the equilibrium between the electric state of the upper strata of the atmosphere and that of the comets and meteorites which approach our earth must take place in a highly rarefied air, and that is where the magnetic poles of the earth are. The analogy between the aurora borealis and the phenomena of electricity observed in tubes containing rarefied air are well known. Prof. Zenger now ascribes the northern lights to the transformation of heat and electricity which is produced by the change in the velocity of the planets and meteorites when they approach our earth, and to the restoration of the equilibrium of the electric state of the planets with that of our earth. A great many labors of Prof. Tacchini, published since 1871, seem to be in perfect accord with this theory.

It is probable, also, that the perturbances in the solar atmosphere, the greatness of which can be seen by the phenomena of the zodiacal light,* is felt even on our earth, and that the atmospheric perturbations and the earthquakes are only retarded manifestations of the great events on the solar surface.

IMPROVED ELECTRIC LAMP.

ONE of the simplest and cheapest forms of lamp is Mackenzie's, manufactured by Strode & Co., of 48 Osnaburgh street, Regent's Park, London. The lamp consists of a platform, P, and an upright standard, C, carrying a lever arm, B', that supports a tubular holder, B, which holds the upper positive carbon, A. A rod, E, from the lever carries the keeper of an electro-magnet, F, which, when the current is passing, is held down, and raises the tubular holder and carbon, so as to form an arc at which the light is developed. When from the consumption of the carbons the current is weakened, the keeper is released, allowing the lever and tubular holder to descend. The small weighted lever and cam, G, being held



ONE-FOURTH SIZE.

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* Other interesting remarks on the same subject are found in "Memoria della Società degli Spettroscopisti Italiani, vol. viii., anno 1878." "Ueber die Periode der Stuerme in beiden Erdhalften." "Nota di P. Tacchini" pag. 38-53. "Sur la Periode des temps de Périhelies de Comètes, del Prof. Zenger," pag. 66-86, vol. iv.

* As regards the zodiacal light, the views somewhat differ.

up by the chain, G', allows the carbon to drop on the lower one, thus making full contact, when the keeper is again attracted, and pulls the lever and holder up again, the small weighted lever and cam descending and holding the carbon tight.

The lower and negative carbon is held in an upright tube, having a spiral spring, H, which propels the carbon upward. The spiral spring is held down by a chain, H', which is attached to it, the other end being wound on a barrel to which an escape-wheel, J, is fixed, and which is released tooth by tooth by the lever, K, and pallets, K', every time the keeper attached to the lever, K, moves up and down. M is a rod to convey the current to the lower carbon. N N are the binding screws or connections. It will be seen that this lamp preserves the focus of light always at one point.

The lamp as shown is calculated to burn five hours, and gives the light of 1,600, with about 4-horse engine power; but it can be constructed to take very long carbons, and consequently burn for a longer time.

We are informed that two of these lamps have been in successful operation at the Exhibition of the Philosophical Society of Glasgow during the past month. The generator used was a small Siemens Brothers' dynamo-machine, requiring about 4-horse power to drive it.

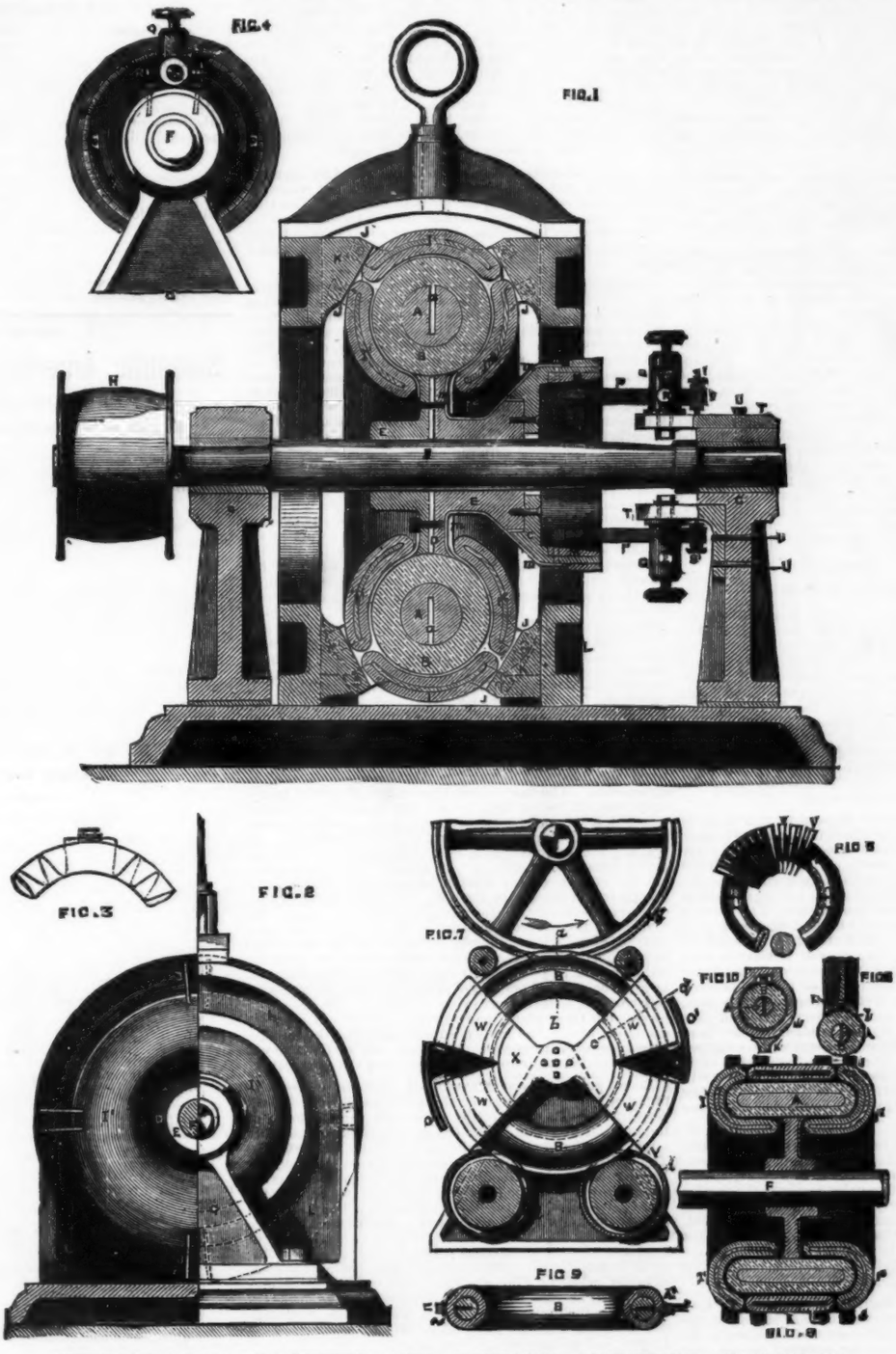
HERR E. SCHÖNE, in the *Berichte*, does not attach any scientific value whatever to the ordinary potassium iodine paper tests as ozone measurers. A small amount of ozone in moist air produces, he says, a greater degree of color on potassium iodide papers than a larger amount of ozone in dry air. The humidity of the air, and the hydroscopic character of the material from which the paper is made, therefore, largely influence the depth of the color produced.

FITZGERALD'S MAGNETO AND DYNAMO ELECTRIC MACHINES.

THE improvements in magneto and dynamo electric machines we now illustrate are the invention of Mr. Desmond G. Fitzgerald, and deserve careful attention, inasmuch as they show a decided advance in the right direction. The main idea of the inventor seems to have been to aim at perfecting the Gramme machine, and so, instead of rotating the ring between the poles of a magnet on the ordinary system, he wholly or partially surrounds the ring both longitudinally and transversely, thus increasing the effective inductive action. The ring is thus magnetized directly, and with the least possible loss, and the direction of the inducting magnetic polarity is in the circle constituted by the ring itself, as it should be.

Fig. 1 shows a transverse sectional elevation of a dynamo-electric machine, Fig. 2 is an elevation partly in section looking on to the left-hand side of Fig. 1, with the driving pulley removed. In Fig. 1 A is the soft iron ring carrying sixty, more or less, coils, B, of the wire, all wound in one direction. The ends of these wires are connected to the collector, C. The ring, A, with its coils, is mounted on a disk, D, attached by a boss, E, to the shaft, F, mounted in suitable bearings on the standards, G G, and at one end carrying the driving pulley, H. The ring, A, is almost wholly surrounded by a hollow electro magnetic ring, I I^1 I^2. For convenience of manufacture the ring, I I^1 I^2, is divided into several portions, of which the two represented by I^1 and I^2 are annular, while two are semi-annular, and make up the largest diameter, I, the division between the halves being preferably at the top and bottom. The separate portions of this hollow magnetic ring are so wound with coils of wire as to constitute two magnets having their like poles opposed on the vertical plane traverse to the ring, A. The reverse direction of the winding near the poles required to produce this effect is shown at Fig. 3. The various sections of the electro-magnetic ring are united and held in position by thin lugs, J, projecting from their cores between the coils of wire. These lugs, J, are bolted to other lugs, K, cast on the frame, L. The ring, A, has preferably a deep recess, *a*, cut in it circumferentially, as shown. The collector, C, consists of a cylinder of wood or other non-conducting material rigidly attached to the boss, E, and having let flush into its inner circumference a series of strips of conducting material, M, insulated, and in number equal to the coils on ring, A. The extremities of the coils are brought to the outside of the collector, and connected so as to form a closed circuit, the points of connection between adjacent coils being severally brought into contact with the conducting pieces, M, as shown at *m m*. Fig. 4 shows clearly the collecting brushes, the current being taken off at the horizontal central line, or the line of greatest polarity. Fig. 4 also shows a front view of the collector, C. The brushes are flat springs of copper, O', each having at one end a contact piece, O, and being attached at the other end to a round bar, P, passing through a terminal, Q, and being fixed in position by a set screw, R. A short lever, S, is fastened to the end of the bar, P, having an adjusting screw, S', tapped through it, and bearing on the plate underneath. This screw enables any required tension to be put on the springs, O', thus regulating the contact friction. The terminal, Q, is fixed to and insulated from a plate, T, connected by screws, U, to the end standard of the machine. The whole of the current collecting portion of the machine is liberated by means of these screws.

Considerable modifications are made in the construction of the ring. The method of construction is shown by Fig. 5. Ordinarily, in winding a number of coils of wire upon a ring, more especially if it be of circular section and if the



FITZGERALD'S MAGNETO AND DYNAMO ELECTRIC MACHINES.

number of turns of wire be the same in each layer, interstices are left between the coils. These interstices are filled by Mr. Fitzgerald with soft iron wedge-shaped blocks, V. These blocks can either be made with the ring, or separately and slipped on, the ring being made in halves to receive them, as shown.

Fig. 6 shows a modified form of the ring, A, and the encircling magnets, I^1 I^2, the ring being cylindrical instead of circular, and the encircling magnets having modified shapes to correspond. The principle is the same whichever form is used. Figs. 7 to 10, however, illustrate a modification in which the ring, A, is wholly encircled on its cross section by coils, W, in lieu of inducing magnets.

Figs. 7 to 10 illustrate a totally new form of machine in which the ring, A, is wholly encircled on its cross section by coils, W, of wire, in lieu of inducing magnets. These encircling coils, W, are supported in a suitable framing, X, and the ring, A, to rotate through them, is mounted between three or more rollers, Y, by one of which—preferably the upper—it is driven by frictional contact, the surface of this roller or pulley being of India-rubber, as seen at *i i*, Fig. 8. The extremities of the coils of ring, A, are attached in a manner similar to that before described to a series of strips of conducting metal, Z, let flush into the external surface of an ebonite or wooden ring, A^1, fitted round the outside of ring, A. The current is taken off at an aperture in the outer circumference of the coils, W, left in each between the coils of wire. Preferably, the coils, W, are wound so as to leave a longitudinal groove, W, on their inner surfaces, where they pass over the ring, A^1, on the outside of ring, A. This allows of the two surfaces of the ring and encircling coils being brought into very close contact. Fig. 8 is a transverse section taken at *a b*. Fig. 9 is a sectional plan of ring, A, at center line, and Fig. 10 a section of coils, W, taken at line, *c d*, Fig. 7.

It is obvious that in the three forms of machines shown permanent magnets may be substituted for the electro-magnets, the permanent magnets retaining substantially the same shape, but being necessarily divided at the points where their similar poles are opposed.

The coils on the ring, A, and those on the inducing electro-magnets, I^1 I^2, or the inducing coils, W, may be connected in multiple arc or in series, as is well understood. The apparatus may be advantageously constructed in duplicate, the current from one of the rings, A, being employed to magnetize both of the hollow electro-magnetic rings and the current for the external portion of the circuit being taken from the second in ring, A. The coiled ring, A, may be inclosed in a casing of soft iron provided with a circumferential slot to allow of the passage of the wires from the coils. The arrangement of the inducing magnets, I^1 I^2, and the coils, W, is applicable to the ring-armatures generally. The saddle-back magnets—as they are called by Mr. Fitzgerald—of double or single curvature, are, the *Electrician* says, applicable to a great variety of purposes.—*The Engineer.*

HORTICULTURAL NOTES.

LIQUID MANURE FOR GRAPES.—The *Rural World* describes a small vineyard belonging to Mr. Poeschel, of Herman, Mo., consisting of an acre and a half of vines, mostly Elvira and Norton's Virginia, with fewer Delaware and Uhland. He feeds these vines heavily with liquid manure—first in the season about the blooming period, and again when the stoning process commences. Small furrows are made above the vines, liquid manure passed along them, and the furrows covered as soon as the soil has absorbed it. The editor states that "he has astonishing results, for four years having an annual return of about $700 from this small piece of ground, and his crop was truly wonderful this year." No estimate is given of the cost of cultivation.

MARKETING FRUIT.—The *Rural Home* says that most of the money paid for fruit by consumers in Rochester goes to the middlemen. Concord grapes have been sold by the growers at one and a half to two cents per pound. They are retailed at the groceries at six cents a pound. Apples bring twenty-five cents to the farmers, and are again sold to consumers at fifty or sixty cents per bushel. The grocers have to buy more than their regular trade demands, so as to make a liberal display before their stores, and one-fourth or one-half will perish on their hands and become a total loss. They must pay shop rents and constant attendance out of their profits, and have something to live on besides. The *Rural Home* proposes that instead of selling to dealers, the farmers shall sell directly to consumers, in which case they must become or employ regular peddlers. They may make contracts with consumers for the season to some extent; but as the supplies and their prices constantly vary, new bargains are to be made as often. Fruit raisers will choose whether to sell their products in the mass at low prices to dealers, or at higher rates by employing a peddler or canvassing vender.

THE ROOT APHIS.—These insects formerly gave much trouble to nurserymen and to the purchasers of trees, checking growth and sometimes ruining the trees. A writer in a late paper states that he has effectually removed the trouble in the following manner: Newly burned lime is broken into small pieces and one-fifth as much flower of sulphur added. The lime is then slaked with boiling water, applying just enough to reduce the mass to fine dry powder. Scrape away the earth from about the roots, moisten them with water, and give them a good coating of the powder.

YELLOWS IN THE PEACH.—Prof. Burrill, of Illinois University, announces the discovery that he has identified the minute cryptogamous plant which causes the yellows in the peach tree. Powerful magnifiers are required to see this plant, which is only 0·000069 of an inch in diameter, and only three times as long. This is about one-fourteen-thousandth of an inch in width, or only one-three hundredth part of the thickness of the paper on which the *Country Gentleman* is printed. These little plants occur in great numbers in the diseased cells of the tree. As with most of the diseases caused by parasitic fungi, it is easier to determine the cause than to find a remedy.

SMOKING ORCHARDS UNSUCCESSFUL.—A correspondent of the *Rural World* describes his attempt in smoking his fifty peach trees to keep off the curculio. A barrel of coal tar was bought, and several holes dug six inches deep through the orchard. Corn cobs were dipped in the tar, placed in the holes, and set on fire. The operator says that he "got a nice smoke," and had his holes to suit the wind. This work was repeated three mornings in each week for a month. The whole process did no good, the young fruit being badly stung. As this remedy is frequently recommended by those who have given it little trial, such failures as this are worth recording. The jarring process, properly conducted, is easier, cheaper, and more efficient; if not properly applied, it is of little use.

PREVENTING PEAR BLIGHT.—D. B. Wier furnishes the *Prairie Farmer* a statement of his remedy to prevent the pear blight, which we think an effectual one. It is "to plant no more pear trees." He thinks the disease is produced by malaria, and that when quinine becomes cheap enough something may be done by way of cure. He asserts that French pear stocks and Angus quince roots will prevent blighting about as much as a black hat would prevent ague in the western river bottoms. Mr. Wier's preventive—to cease planting—is good as far as it goes, and allied to it is planting only those sorts which nearly always escape, namely, Duchesse, Seckel, and Winter Nelis, to which Clairgeau will probably be added in time.

SETTING OUT BLACKBERRIES.—E. P. Roe, in his valuable work on Small Fruits, recommends setting out blackberries either in autumn or very early in spring. He asserts that set at either of these periods "the plants will thrive if they have the ghost of a chance," and that more difficulty will be found in making them die than live. Late spring setting is more unsuccessful. The soil should be mellow, deep, and well drained, but not rich. Shade and moisture produce rank growth, not enduring winter. On hard, dry ground, the fruit often never matures. The treatment of the plants is management rather than culture. More can be done with the thumb and finger at the right time than with the savage pruning shears after a year of neglect.

PLANTS IN ROOMS.—It has been fully proved by chemical examination and otherwise, that plants in living rooms, or in bedrooms, rather purify the air than otherwise. Yet they may in some cases prove injurious in sick rooms, when the odor is offensive to invalids. Whatever annoys the sick does harm to a greater degree than healthy persons can understand.

FRUIT TRADE AT BALTIMORE.—Forty thousand persons have been employed this season at Baltimore in handling and taking care of the fruit which came to the city from different parts of Maryland. This number included gatherers, packers, clerks, shippers, driers, canners, etc. About 150,000 cans were put up each day, taking about half the fruit reaching the city. Two-thirds of the remainder were shipped to other points. One-sixth or less of all the fruit received was consumed in a fresh state in the city. These statements, which have been given in the journals, show how important the canning, drying, and shipping business has become, as compared with the actual consumption of a single large city.

WATERING PLANTS AND TREES.—Speaking of watering shrubs and trees, the *Gardener's Chronicle* says: "It is the incessant driblets that do the harm, for it frequently happens that the top soil looks sodden when the portion about the roots is almost dust dry." This remark is worthy of being recorded, although the season for out-door watering has passed. But it will apply well to house plants, which must receive an artificial supply of water the year through; their treatment, however, is generally well understood. It is more frequent that out-door watering is wrongly performed, and very often the watering does more harm than good. Some years ago, an experiment was made on a row of newly set cherry trees in a dry season. A portion was occasionally watered; in another portion it was omitted; a third was mulched. The watering soaked the surface, which was afterward baked into a hard crust, excluding from the soil below all subsequent waterings, and preventing the benefit derived from a mellow surface. Most of these watered cherry trees died the same summer. Nearly all the unwatered ones lived, but they did not have a vigorous, healthy appearance. The trees which were mulched several inches deep with old hay as soon as the hot weather of summer came, all lived, and the leaves had a green, healthy appearance. This contrast might not occur in moist seasons. In hot, dry weather, nothing is more important for newly set cherry trees than mulching. It appears to be less important for other trees, for which a clean, mellow surface for several feet appears to be the best. We have recommended on former occasions, when watering became necessary, the removal of the soil from the surface down to the roots, then pouring in the water copiously and replacing the earth. But unless this operation is repeated often enough to keep the soil about the roots constantly moist, it will be of little service. The greatest amount of water is taken up by plants and trees in a thrifty, growing condition, with plenty of leaves; but these plants have already thrown out roots far enough to obtain the needed supply, provided the soil has been kept loose and mellow, and grass and weeds have not been permitted to pump the moisture from the earth below.

ROSES FOR GARDEN CULTURE.—I send list of roses as promised. It comprises one dozen of established hybrid perpetuals, half a dozen of the newer sorts, and a dozen of the old and new teas. The list of hybrid perpetual roses might be varied somewhat without materially weakening it. Thus Alfred Colomb might be substituted for Mad. Victor Verdier, and perhaps should be, though the latter seems the better grower. No one can say absolutely which are the best twelve roses, and the list would be very likely changed if made out anew by the same hand. The list recently made in France by eighty-five amateurs places La France at the head and Alfred Colomb near the foot, while a popular list made in this country with great care, gives Colomb the place of honor, while La France ranks tenth, though the author says that if he were compelled to choose only one variety it would be the latter. Possibly in the French collection national pride had something to do with the rank given La France, and perhaps climate had more.

The list which I inclose is certainly a good one, and gives a wide range of color, with intermediate shades. The newer ones seem fine so far as tested. Neither list is given in the strict order of merit. Of the newer teas, to my mind, Marie Guillot should lead the list. It remains in perfection a long time. Cut in the right state (a half-opened bud), it will last two or three days, where Bon Silene or Safrano would fly open in as many hours. It is of faultless form with beautifully imbricated petals. The color is a delicate lemon white. Perle des Jardins is almost equally fine, but of a deep canary color. Duchess of Edinburgh is perhaps the finest dark crimson we have. Marie Van Houtte, a delicate yellow, frequently tinted with rose and of fine form, is entitled to a place on the list. Riza du Parc is a good, bright mottled rose and a free bloomer. Catherine Mermet would complete the list were it not of such feeble growth. Aline Sisley, purplish rose, although not its equal in beauty, will take its place.

Of the older teas (and they should by no means be neglected), Safrano, Malmaison (Bourbon), Gloire de Dijon, Isabella Sprunt, Bon Silene, and Marie Ducher, will be found satisfactory. Were I confined to a single variety it would still be Safrano, as the most useful of all roses. The old hardy Bourbon, Hermosa, should also be in every garden. All the above are of free growth, and the range of colors is good. Some of those varieties, so beautiful when grown under glass, cannot be recommended for out-door culture. Such are Marshal Niel, Niphetos, and Cornelia Cook. An occasional fine specimen may be obtained, but as a rule they are not satisfactory. My own experience in rose culture has been confined entirely to garden cultivation.

HYBRID PERPETUALS.

La France,	Countess Cecile de Chabrillant.
Louis Van Houtte,	Coquette des Blanches,
Mad. Victor Verdier,	Duke of Edinburgh,
Anne de Diesbach,	Marie Bauman,
Gen. Jacqueminot,	Victor Verdier.
Abel Grand,	

NEW HYBRID PERPETUALS.

Rev. J. B. Camm,	Countess Serenye,
Miss Hassard,	Climbing Jules Margottin,
Mabel Morrison,	Francois Michelon.

NEW TEAS.

Marie Guillot,	Marie Van Houtte,
Perle des Jardins,	Riza du Parc,
Duchess of Edinburgh,	Aline Sisley.

OLDER TEAS.

Safrano,	Isabella Sprunt,
Bon Silene,	Marie Ducher,
Gloire de Dijon,	Malmaison.

—*R. A. M., in Country Gentleman.*

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TABLE OF CONTENTS.

PAGE

I. ENGINEERING AND MECHANICS.—The Treatment of Silver Tailings in Nevada. By T. EGLESTON, Ph.D. 3 figures. Views of the Woodworth Silver tailing sluices at Dayton, Nevada..... 4192
Progress in Shipbuilding..... 4194
Improved Boat Lowering Apparatus. 4 figures. The Donovan boat lowering and detaching apparatus..... 4189
Cost of Dredging..... 4190
Prismatic Gunpowder..... 4190
Detailed Cost of a Passenger Day Coach..... 4196
Improved Steam Carriage for Street Use. 1 figure. German steam carriage for ordinary roads..... 4190
Improved Rock Drill. 8 figures. Sachs' improved rock drill..... 4193
Improved Multitubular Gas Boiler. 2 figures..... 4197
A Tube Exhibit in the Dusseldorf Exhibition. 1 figure..... 4197
Improved Taking-Off Apparatus for Printing Presses. 1 figure. 4198
Improved Power Press. 2 figures. Power press with elastic bed. 4200
Improvements in Spinning Machinery. 5 figures..... 4198
Apparatus for Regulating the Temperature of Gas Stoves. 1 figure..... 4199
Laval's Centrifugal Cream Separator. 2 figures..... 4200
Scientific Fenestration. An investigation of the proper forms, dimensions, number, and positions of windows for buildings for various purposes..... 4200

II. PHYSICS, METEOROLOGY, ETC.—Air Thermometers. By D. WINSTANLEY. 1 figure..... 4194
Experimental Illustration of Minimum Energy. 2 figures. Apparatus shown to the British Association by Sir William Thomson. 4192
Progressive Movement of Storms..... 4198
Relation between Terrestrial Tempests and the Rotative Periods of our Solar System..... 4199

III. ELECTRICITY.—Improved Electric Lamp. 1 figure. Mackenzie's lamp..... 4200
Fitzgerald's Magneto and Dynamo Electric Machines. 10 figures. 4191

IV. HORTICULTURE, ETC.—The Mould of Bread. 7 figures. Growth of bread mould, as seen with the microscope..... 4195
Horticulture Notes: Liquid manure for grapes.—Marketing fruit.—The root aphis.—Yellows in the peach.—Smoking orchards unsuccessful.—Preventing pear blight.—Setting out blackberries.—Peonias.—Plants in rooms.—Fruit trade in Baltimore.—Watering plants and trees.—Roses for garden culture..... 4198

V. MISCELLANEOUS.—Yankees in Russia..... 4195
What Industry and Thrift can do in the West..... 4196
The Mennonites..... 4196
Growth of American Cities..... 4196
Savings by Postage Stamps..... 4194
The Birthplace of Montezuma. By THEO. S. CASE. 2 figures. Pueblo Village at Pecos, New Mexico. Plan of Ruins..... 4204
Smyrna. Resources, agriculture, etc..... 4199

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